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ABSTRACT

This paper incorporates the work of several authors and presents a project focused on the competency training of teachers in environmental education. Draft competency lists included: (1) scientific knowledge for elementary school teachers; (2) processes in science for the elementary school teacher; and (3) teaching science to elementary school age children. The Florida and AAAS guidelines and other Competency-Based Teacher Education Program (CBTEP) materials were major input sources. After selection of the teachers for the CBTEP training in environmental education competencies, a series of informal training sessions were conducted. Materials related to the SCIS Life Science Units were utilized. Questionnaires, classroom visits, anecdotal records of classroom activity written by the teacher and samples of children's work provided data for the project. A modification of the Richmond Evaluation of Teacher Objectives for Environmental Unit instrument was administered to the teacher at the conclusion of the unit. Conclusions and recommendations were made concerning the effectiveness of the program. These are listed in the final report. (Author/EB)

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THE CITY UNIVERSITY OF NEW YORK
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# A COMPETENCY-BASED SCIENCE EDUCATION PROGRAM FOR THIRD THROUGH SIXTH GRADE LEVEL ELEMENTARY TEACHERS UTILIZING TRAINING MODULES WITH SCIS ENVIRONMENTAL EDUCATION MATERIALS IN AN URBAN UNIVERSITY-SCHOOL COOPERATIVE FIELD PROJECT: A FINAL REPORT

Edited by: Allan Freedman, Program Director, Office of Teacher Education

Jerrold William Maben, Herbert H. Lehman College

1973

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## A FINAL REPORT

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1973

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THE CITY UNIVERSITY OF NEW YORK
Office of Teacher Education

# A Competency-Based Science Education Program for Third Through Sixth Grade Level Elementary Teachers Utilizing Modules with SCIS Environmental Education Materials in an Urban University School Cooperative Field Project: A Final Report

Edited by: Allan Freedman, Program Director, Office of Teacher Education
Jerrold William Maben, Herbert H. Lehman College

## ABSTRACT

Background

During the 1971-1972 academic yeai Competency-Based Teacher Education Program (CBTEP) Science Committee developed draft competency lists in three areas:

1) Scientific knowledge for elementary school teachers.

2) Processes in science for the elementary school teacher.

3) Teaching science to elementary school age children.

The Florida and AAAS guidelines and other CBTEP materials were major input sources. For 1972-1973 a goal was set to train selected classroom teachers at the third, fourth, fifth and sixth grade levels in specific competencies for teaching environmental education. A CBTEP subcommittee on environmental education was formed. Science Curriculum Improvement Project (SCIS) materials were selected to use in the competency-based training of the selected teachers at four centers within the City University of New York. The Lehman College Center was designated to select and train a third grade teacher in one of the Bronx school districts. The Richmond College Center was designated to select and train two fourth grade teachers in a school in Staten Island; The City College Center was designated to select and train a fifth grade teacher in Upper Manhattan and the York College Center was designated to select and train a sixth grade teacher in a school in Jamaica, Queens, New York.

## The Field Projects

After selection of the teachers for CBTEP training in environmental education competencies, a series of informal training sessions at the respective teachers' schools were conducted during the 1972-1973 school year. Materials related to the SCIS Life Science Units were utilized in each session. The training was designed for competency development in three areas:

1) General Teacher Competencies in Environmental Education.

2) Specific Teacher Competencies in Environmental Education.

3) Specific Environmental Education Teaching Competencies.

The teachers were provided with the set of SCIS materials for use in their classrooms during the Spring Semester 1973.

## Evaluation

The focus of the project was on the competency training of five teachers in environmental education. The Maben National Elementary Science Study Questionnaire was administered for background baseline data on the teachers. The teachers' classroom was visited periodically during the conduct of the Life Science Units. Anecdotal records of classroom activity were written by the teacher. Samples of children's work in written and art form were collected. Results of the program were discussed during the training sessions. A modification of the Richmond Evaluation of Teacher Objectives for Environmental Unit instrument was administered to the teacher at the conclusion of the unit. Conclusions and recommendations were made concerning the effectiveness of the Competency-Based Teacher Education Field Project Training Modules.

# A Competency-Based Science Education Program for Third Through Sixth Grade Level Elementary Teachers Utilizing Modules with SCIS Environmental Education Materials in an Urban University School Cooperative Field Project: A Final Report

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## INTRODUCTION

In the effort to improve the quality of teacher education, some have strongly indicated that "sharp, solid judgements of competence and ability for achieving competence for both individuals and institutions is indeed long overdue in education."[1]

Concern for improvements in elementary science teacher preparation has resulted in examination of the feasibility of competency-based teacher education programs (CBTEP). CBTEP have been described by the American Association of Colleges of Teacher Education (AACTE)[2] as having several essential common elements that are not characteristic of other teacher training programs. These elements relate to statements before instruction begins of specific goals for levels of competency to be achieved by participants in the respective teacher training programs. Although the AACTE[3] has indicated that CBTEP is now firmly established in the United States, it has been demonstrated that much remains to be done in terms of operating teacher education programs in specific curriculum content areas.[4]

In recognition of the state of the art and the demands posed by the New York State Regents Master Plan for Teacher Certification,[5] the City University of New York (CUNY) Office of Teacher Education, under the direction of Dr. Benjamin Rosner, University Dean of Teacher Education, convened in January, 1972 150 faculty members to begin a feasibility study of

implementing a major revision of teacher education programs. As part of the preliminary phase of the study, the faculty participants "read extensively from the most recent pertinent literature, discussed major philosophic and practical concerns, met with a number of consultants who have been instrumental in the conceptualization of the competency-based notion and have begun the important job of specifying and defining those particular competencies which are thought to be most essential for beginning teachers to possess in order that they may facilitate pupil learning."[6] To implement the later task in the feasibility study, CUNY CBTEP committees were formed in twelve areas of concern, including science education.

During the Spring of 1972, the CUNY CBTEP Science Education Committee focused on the statement of teacher competencies for the teaching of elementary school science. The Florida Catalogue of Teacher Competencies[7] and the American Association for the Advancement of Science (AAAS) Preservice Science Education of Elementary School Teachers - Guidelines, Standards and Recommendations for Research and Development[8] were found to be of particular value for use in developing the draft competencies. The final product of the Science Education Committee[9] was a draft statement of competencies in three areas of teacher education:

A. Competencies in Scientific Knowledge for the Elementary School Teacher.

B. Competencies in the Processes of Science for the Elementary School Teacher.

C. Competencies in Teaching Science to Children at the Elementary School Level.

A. Competencies in Scientific Knowledge for the Elementary School Teacher

1. The teacher will be able to describe observations of living and non-living objects in terms of their physical, chemical and biological composition, characteristics, and structure.
2. The teacher will be able to describe observed interactions of living and non-living matter using concepts such as forces, electrical charges, magnetic fields, biological tropisms and food webs, and the interactions which exist among living organisms in ecosystems.
3. The teacher will be able to describe the inter-relationship between mass and energy from one form to another and the transformation of energy in living and non-living systems.
4. The teacher will be able to describe the processes of growth, reproduction and evolution in plants and animals.
5. The teacher will be able to describe the conceptual structure of the earth, the universe and the biotic world.
6. The teacher will be able to describe the relationship of the progress of science to the development of modern thought and will be able to state evidence of changes in society and culture in the products of scientific work and of the influence of social conditions and scientific activities.

B. Competencies in the Processes of Science for the Elementary School Teacher

1. The teacher will be able to distinguish observations and evidence from inferences and conclusions and will be able to demonstrate the ability to make inferences when presented with empirical data.

B. Competencies in the Processes of Science for the Elementary School Teacher (continued)

2. The teacher will be able to state a problem to be investigated on the basis of phenomena observed, and to identify the variables which affect the result of the investigation.
3. The teacher will be able to demonstrate the measurement of variables such as length, mass, time in metric and arbitrary units.
4. The teacher will be able to collect and to organize and classify data and describe the rationale for the organization and/or classification.
5. The teacher will be able to construct, test and modify hypotheses, and/or generalizations based upon data, problems, or inferences.
6. The teacher will be able to construct and to test hypothetical models or systems being studied which contain the essential variables and their relationships.

C. Competencies in Teaching Science to Children at the Elementary School Level

1. The teacher will be able to demonstrate the ability to teach science as inquiry to children by emphasizing investigation over rote learning.
2. The teacher will be able to demonstrate the ability to select and utilize experiences and materials appropriate to the physical and intellectual maturity of school children.
3. The teacher will be able to demonstrate the ability to lead children through discovery activities using such techniques as questioning, accepting and building upon children's answers, and encouraging further pupil investigations.

C. Competencies in Teaching Science to Children at the Elementary School Level (continued)

4. The teacher will be able to establish and maintain a classroom environment conducive to the learning of science by structuring the learning situation to maximize each student's acceptance of responsibility for thinking for himself and minimize the teacher's thinking for the student.
5. The teacher will be able to use science activities in such a manner as to encourage positive self-attitudes among the children.
6. The teacher will be able to develop plans for the evaluation of student progress in science.

Upon completion of the Draft of Competencies, the CUNY CBTEP Science Education Committee took as an appropriate next step the area of environmental science education in which it would focus its attention in developing specific teacher competencies. Reasons for selecting this content area included:

a. Study of the environment by children at every grade level was considered to be an advantage in establishing competencies that would be useful and important to the professional training of elementary school teachers.
b. Public elementary schools in the CUNY geographic service region[10] would be receptive to teachers who have been trained in environmental science education.
c. Science course improvement project materials were available for environmental science education instruction.

d. Study of elementary school teacher competencies in aspects of environmental education could make a significant contribution to both science education and CBTEP.

A CBTEP Environmental Education Committee (EEC) working group was formed from the CUNY CBTEP Science Education Committee. The Committee decided the environmental education project would combine field testing with theoretical competency development and it would begin to test CBTEP procedures with classroom teachers who face the complex problems of teaching in New York City schools. Noting movements in teacher education that are not empirically-based, Dean Rosner stated:

> We are aware of the fact that too much of teacher education has drifted away from an empirical base to reflect the political ideologies of one or another clique. If teacher education is to be anchored in knowledge, if it is to be anchored in the real world, if the knowledge and the skills to be developed are to be demonstrably related to performance in real classroom settings or in other instructional environments, then teacher education must get about the business of demonstrating that its curriculum possesses a sufficient degree of power to enable teachers to function effectively in the real world of the public schools.

The Environmental Education Committee (EEC) (by its empirical approach) sought to gather evidence in support of competency-based teacher education as an hypothesis for further testing in accord with the position noted above.

"The position that I have taken is that competency-based teacher education is indeed an hypothesis, that it remains to be tested, that we must test it, and that there is no other equally powerful hypothesis to guide the future development of teacher education." [11]

As a result of Environmental Education Committee (EEC) discussions, a three phase plan of action was developed. First, the draft listing of

desired teacher competencies in environmental science education was to be continued. Second, training modules for the desired competencies would be designed. Third, in-service New York City elementary school teachers at the third, fourth, fifth and sixth grade levels would be selected for field trial of the training models.

Continued draft competency listing and training module design proceeded largely as a total committee endeavor. For the third phase, it was decided that each of the four CUNY senior colleges represented would select a grade level and serve as a Field Project Center. The responsibility of the Committee member at each College Center included identification and selection of a cooperating elementary school in the service area of that Center. In turn, a teacher at the respective grade level in the cooperating elementary school would be identified. As soon as the appropriate arrangements had been made, the training of the cooperating teacher in the desired environmental science education competencies could begin.

As part of the first and second phases, the Environmental Education Committee (EEC) was concurrently refining draft teacher environmental competencies. During this period the Environmental Education Committee (EEC) also reviewed Science Course Improvement Project curricula and materials in an effort to select those that would be readily adoptable for use in the training modules. It was decided that the Science Curriculum Improvement Study (SCIS) Life Science program would be utilized in the training modules. The SCIS units selected for use in the respective centers were the following:

| | | |
|---|---|---|
| Third Grade | - | Populations |
| Fourth Grade | - | Environments |
| Fifth Grade | - | Environments |
| Sixth Grade | - | Ecosystems |

Four teaching strategies of the SCIS Life Science Program: exploration, discovery, invention and reinforcement, added to the adaptability of the program for use in the CBTEP competency teaching modules at the College Centers.

Another advantage of the SCIS Life Science Program for use in the environmental competency teacher training modules was a high degree of correspondence between SCIS program objectives and biological science competencies stated in Sections A and B of the Draft Competencies List, respectively. Competencies in Scientific Knowledge for the Elementary School Teacher, p. 3 above, and Competencies in the Processes of Science for the Elementary School Teacher, pp. 3-4 above. The SCIS Teacher's Guide[12] listed the following life science concepts for exploration, discovery, invention and reinforcement activities in each Unit:

Populations Unit

| | |
|---|---|
| Population | Plant Eater |
| Predator | Animal Eater |
| Prey | Food Chain |
| Community | Food Web |

Environments Unit

| | |
|---|---|
| Environment | Environmental Factor |
| Range | Optimum Range |

Ecosystems Unit

| | |
|---|---|
| Ecosystem | Oxygen - Carbon Dioxide Cycle |
| Pollutant | Food - Mineral Cycle |
| Water Cycle | |
| Community | |

In addition, SCIS Life Science Units were designed to review and extend concepts incorporated into learning experiences designated for Level I, Organisms and Level II, Life Cycles, as well as to introduce Level VI, Ecosystems, concepts. Stated concepts from these related units were:

Organisms Unit

| | |
|---|---|
| Organism | Habitat |
| Birth | Food Web |
| Death | Detritus |

Life Cycles Unit

| | |
|---|---|
| Growth | Genetic Identity |
| Development | Plant and Animal |
| Life Cycle | Biotic Potential |
| Generation | Metamorphosis |

Ecosystems

| | |
|---|---|
| Producer | Photosynthesis |
| Consumer | Food Transfer |
| Decomposer | Raw Materials |
| Community | |

The CUNY CBTEP Environmental Education Committee (EEC) decided to provide classroom teachers from cooperating elementary schools in the College Centers with instructional materials for SCIS units used in each competency-based teacher training module. As a result, cooperating teachers in each center had opportunity to utilize their developed competencies in their own classrooms. By having each experienced teacher use SCIS materials in his regular classroom and involving children with whom they already had a professional relationship, the CBTEP Environmental Education Committee (EEC) was able to study additional

aspects of the Draft Competencies List, Section C, Competencies in Teaching Science to Children at the Elementary School Level, pp. 4-5 above. The Centers and the grade levels selected for the Environmental Education Committee (EEC) study during the Spring semester, 1973 were: The Herbert H. Lehman College Center, third grade, the Richmond College Center, fourth grade, The City College Center, the fifth grade, and the York College Center, the sixth grade. In each instance commitments were obtained from the school administration and the prospective teacher to cooperate in the program. The cooperating classroom teacher agreed to participate in training via competency modules, to teach the entire SCIS Life Science Units, to maintain necessary records and to assist in appropriate evaluation procedures.

Summary

In January 1972 the City University of New York (CUNY) began a feasibility study of Competency-Based Teacher Education Program (CBTEP). A CUNY CBTEP Science Education Committee was formed and a Draft Competency List was subsequently formulated for three science education areas: a. Scientific knowledge for elementary school teachers; b. Processes in science for the elementary school teacher; and c. Teaching science to elementary school age children. The Florida Catalog of Teacher Competencies and the American Association for the Advancement of Science (AAAS) Preservice Science Education of Elementary School Teachers Guidelines were major resource documents along with a wide range of other CBTEP materials. Committee members also participated in CUNY CBTEP workshops, seminars and lectures.

Goals were set by the Science Education Committee for the 1972-1973 academic year which included: a. Formation of a CBTEP Environmental Education Committee (EEC) as a working group; b. Continued refinement by the

Environmental Education Committee (EEC) of teacher competencies related to environmental education and c. Field trial of competency-based teacher education in four CUNY College Centers. The Field Centers in public schools in the Bronx, Staten Island, Manhattan and Queens were designated to select and train third through sixth grade classroom teachers respectively. Science Curriculum Improvement Study (SCIS) Life Science Populations Unit materials were used in the Field Project Centers.

Overview

This Final Report of a Field Project in Competency-Based Teacher Education is divided into the following sections: I. Introduction; II. The Field Projects; and III. Evaluation, Recommendations and Summary.

## THE FIELD PROJECTS

### Introduction

The main functions of the four Field Project Centers for the Environmental Education Committee of The City University of New York Competency-Based Teacher Education Program (CBTEP) were to: a. select a cooperating elementary school for participation in the competency training field project; b. train an elementary grade teacher from the cooperating school in stated environmental education competencies; c. develop environmental education competency training modules based on the stated competencies and incorporating Science Curriculum Improvement Study (SCIS) Life Science Unit materials into learning activities of the twelve modules; d. furnish assistance as part of the teacher's competency training for classroom implementation of the SCIS Populations Unit; and e. provide, to the Environmental Education Committee (EEC), evaluative data concerning development of the competency training modules, teacher training with the modules and implementation of the SCIS Life Science Units for comparison with field work among the other Field Project Centers.

The present section of this Report, the Field Project, is concerned with processes involved in: 1. cooperating school and teacher selection; 2. competency-based training of the selected elementary grade teachers; and 3. classroom implementation of SCIS Life Science Unit instruction. Information on evaluation data will be found in the next section of this report, Evaluation, Recommendations and Summary. This Report section is divided into the following subsections: a. The Cooperating Schools; b. The Cooperating Teachers; c. Competency Training Modules; d. Environmental Education Competencies; e. Classroom Unit Implementation; and f. Summary.

The Cooperating Schools

Several criteria were used in selecting the cooperating schools. The major criterion was location. All cooperating school sites were within the geographic service areas of the participating colleges.

The principals of the selected schools agreed to cooperate with the field project directors in the environmental education competency-based field project. The teachers would be permitted to devote requisite time to SCIS instruction in their classrooms and arrangements would be made for children to take school neighborhood field trips related to classroom SCIS activities in environmental science. The EEC representatives could conduct CBTEP training modules in the classrooms and make the necessary number of visitations for observation, conference and coordination.

The Cooperating Teachers

Utilizing assistance from the principals, full time teachers of grades 3-6 were selected for the field project. The Maben National Science Teaching Study Elementary Teacher Questionnaire, Appendix A, was administered to obtain teacher background information. Comparative data of cooperating teachers are shown in Table 1, p. 29.

Competency Training Modules

A training module is a set of experiences intended to facilitate learner demonstration of competencies. The modules developed for this program met a basic criterion as set forth by Houston:

"Modules are not isolated curriculum bits but flexible and integrated instructional strategies." [13]

Teacher Competency Training Modules were scheduled for a period beginning about eight weeks before the teachers were to begin the SCIS Units in their

classrooms and concluding with a final session after the classroom unit was completed. The total time span was equivalent to approximately a college semester.

All competency training modules employed informal teaching techniques. The teachers were encouraged to manipulate the SCIS materials, to attempt varied ways of accomplishing purposes of a given activity, to correct their own errors; and to suggest ways in which lesson purposes could be attained with children. Each module was designed to provide for competency development in scientific knowledge, science processes and science teaching.

The EEC representatives were the instructors for all competency training modules. Standard science texts, science education references, children's science trade books, SCIS Newsletters and the SCIS Populations Unit Teacher's Guide were used in coordination with the SCIS equipment kit. Time was provided in each module for assessing progress in classroom implementation of the SCIS Life Science Units.

The Environmental Education Competency Training Module sequence closely approximated the SCIS unit schedule in the Teacher's Guide. The schedule appears in Appendix C. Materials for the training modules were used from the regular SCIS kits which had been provided for use by the cooperating teacher in the classroom.

The following list of Environmental Education Competency-Based Teacher Education Program (CBTEP) Training Modules developed and implemented by the Lehman College Center were representative of the modules developed by the other College Centers. A list of these training modules appear in Appendix C, pp. 82-86.

| | |
|---|---|
| Module I | Competency objectives; philosophy of SCIS program; psychology of learning; teaching techniques; CBTEP overview; schedule; and administration of Elementary Teacher Questionnaire. |
| Module II | Animal, plant, habitat, living and non-living concepts; observation and recording processes; and use of magnifiers, cultures and live materials and classroom management of materials. |
| Module III | Growth, development and population concepts; observation and prediction processes; and growth of brine shrimp and clover seeds and setting up classroom experiments. |
| Module IV | Concept of populations in natural environments; comparison, estimation, measurement and prediction processes; and using varied recording methods and school neighborhood field trips with children. |
| Module V | Life cycle, growth, development, generation and plant eater concepts; observing, model formation and recording processes; and growing peas, daphnia and algae and using invention lessons. |
| Module VI | Population, birth, death and dispersal concepts, controlled experimentation, observation, recording operational definition development and inference processes; and helping children to identify variables and organize investigation teams. |

Module VII — Food relationships, food chain, plant eater and animal eater concepts; measurement skills; and setting up terraria with children.

Module VIII — Food chain concepts; observation and predicting skills; growing clover, grass, mustard, pea, aphid and cricket population in terraria as classroom investigation.

Module IX — Food relationships, animal eater, predator, prey, food chain and food web concepts; using recorded observational evidence; invention lessons.

Module X — Food relationships among aquatic populations concept; inference observation and recording processes; growing anacharis, wolffia, snail and damselfly populations for child investigation of aquatic relationships.

Module XI — Community and interdependent population concepts; communities in natural environment of school neighborhood; children as part of natural community.

Module XII — Assessment, review and administration of Evaluation of Teacher Objectives for Environment Unit instrument.

Module training sessions were scheduled on days and at times mutually convenient for the cooperating teacher and the EEC representatives. The period following the elementary school day provided the most convenient time period for training since the training sessions could be ended when a module sequence was completed rather than having discontinuities occur if the sessions had been confined to a limited school schedule.

Environmental Education Competencies

Final draft lists of teacher competencies for environmental education were a product of the total CUNY CBTEP Environmental Education Committee (EEC).

The draft lists used in designing competency training modules varied according to the content area studied: Populations, Environments, or Ecosystems. However, all EEC draft environmental education competency lists included the following three areas for teacher training:

a. General Teacher Competencies in Environmental Education.

b. Specific Teacher Competencies in Environmental Education.

c. Specific Environmental Education Teaching Competencies.

Competency lists developed for design of training modules used in Field Project Centers were related to the SCIS Life Science Unit as well as to the EEC Draft Competencies List. SCIS materials utilized, other science education materials selected and all the training modules in which the materials were included were directed toward teacher achievement of listed competencies. Assessment of the levels of achievement of each competency would be measured by teacher self-evaluation, that is, teacher self-awareness of change, and by descriptive statements made by the trainer. No specific competencies criteria levels of achievement were designated. Rather, a major purpose of the project was to obtain relative measures of teacher self-assessment of acquisition of the specific competencies.

The competency list contained a total of 67 general and specific environmental education competencies. The EEC objective was to study the feasibility of working within a particular science education content area; namely environmental education rather than an attempt to study more global competency goals for education in general. The objective with respect to the 67 competencies was realized through discussion of the modules with the teachers, during the

training sessions, in teacher feedback on the modules, and in all related evaluation which appears in Appendix C. It was felt the content of the modules helped to develop general education competencies such as motivation, classroom management and grouping as well as general science education competencies such as description of living and non-living objects in terms of physical, chemical and biological composition, characteristics and structure and description of transformation of energy in living and non-living systems.

A. General Teacher Competencies in Environmental Education

1. The teacher will be able to identify the environmental factors which affect living organisms.
2. The teacher will be able to describe the environments of organisms.
3. The teacher will be able to describe interrelationships between human and other organisms with their environment.
4. The teacher will be able to develop models which evaluate the relationships between changes in organisms and their environment.
5. The teacher will be able to describe the range of environmental factors as it occurs in an experiment or outdoors.
6. The teacher will be able to determine by experiment the best range of an environmental factor for an animal.
7. The teacher will be able to describe the growth responses of plants under differing environmental conditions.
8. The teacher will be able to determine by experiment the optimum range of several environmental factors for plants.
9. The teacher will be able to describe similarities and differences in the responses of plants and animals to changes in environmental factors.

A. General Teacher Competencies in Environmental Education (continued)

10. The teacher will be able to use experimental data when planning the construction of a terrarium.

11. The teacher will be able to construct a terrarium providing optimum ranges of some environmental factors.

B. Specific Teacher Competencies in Environmental Education

1. The teacher will be able to set up a terrarium.

2. The teacher will be able to identify living and non-living objects.

3. The teacher will be able to develop operational definitions of the terms organisms, population and habitat.

4. The teacher will be able to detect population changes within a specific environment.

5. The teacher will be able to record changes in the population of a specific environment.

6. The teacher will be able to invent models which describe changes within the environment.

7. The teacher will be able to identify specific environmental factors which affect population changes.

8. The teacher will be able to develop an operational definition of the term environment.

9. The teacher will be able to record observations relative to environment changes such as precipitation and temperature.

10. The teacher will be able to lead a series of field trips to evaluate living organisms in a particular area.

11. The teacher will be able to evaluate the responses of a specific living organism to a variety of temperatures.

B. Specific Teacher Competencies in Environmental Education (continued)

12. The teacher will be able to use observational methods to investigate environmental phenomena.
13. The teacher will be able to relate and compare observational data with reference material.
14. The teacher will be able to record environmental data in several ways.
15. The teacher will be able to use recorded data to infer time relationships.
16. The teacher will be able to design an experiment to investigate the salt water environment to hatch shrimp eggs.
17. The teacher will be able to measure the growth of seedlings and will be able to record the measurements.
18. The teacher will be able to determine the average growth for each plant.
19. The teacher will be able to conduct a controlled experiment in relation to plant responses to light.
20. The teacher will be able to conduct a controlled experiment to determine the feeding relationships of herbivore such as Daphnia.
21. The teacher will be able to conduct a controlled experiment to determine the feeding relationships of carnivore such as the chameleon.
22. The teacher will be able to identify interacting populations in aquaria and terraria.
23. The teacher will be able to make inferences about food chain and food web relationships in nature.

B. Specific Teacher Competencies in Environmental Education (continued)

24. The teacher will be able to illustrate predator and prey relationships.

25. The teacher will be able to develop an operational definition of the term community.

C. Specific Environmental Education Teaching Competencies

1. The teacher will be able to guide children in setting up terraria.

2. The teacher will be able to help the children to distinguish between living and non-living objects.

3. The teacher will be able to help the children develop operational definitions of such terms as organisms, population and habitat.

4. The teacher will be able to guide children in detecting population changes within a terrarium.

5. The teacher will be able to help children in recording changes in population within a terrarium.

6. The teacher will be able to help children identify specific environmental factors affecting population changes within an aquarium.

7. The teacher will be able to help children to identify specific environmental factors which affect population changes within a terrarium.

8. The teacher will be able to help the children develop an operational definition of the term environment.

9. The teacher will be able to help children describe interrelationships among humans and other organisms and their environment.

10. The teacher will be able to help children to develop models which evaluate the relationships between changes in organisms and their environment.

C. Specific Environmental Education Teaching Competencies (continued)

11. The teacher will be able to help children record observations relative to environmental changes such as precipitation and temperature.
12. The teacher will be able to help the children become aware of living organisms in particular areas through field trips.
13. The teacher will be able to help children describe the range of an environmental factor as it occurs in an experiment or outdoors.
14. The teacher will be able to help children determine by experiment the best range of an environmental factor for an animal.
15. The teacher will be able to help children to investigate environmental phenomena by observational methods.
16. The teacher will be able to help children to relate and compare their observations with information presented in reference materials.
17. The teacher will be able to help children to record environmental data in several ways.
18. The teacher will be able to help children to use recorded data to infer time relationships.
19. The teacher will be able to help children design an experiment to investigate the salt water environment to hatch shrimp eggs.
20. The teacher will be able to help children measure and record the growth of seedlings.
21. The teacher will be able to help children determine the average growth for each plant.
22. The teacher will be able to help children conduct a controlled experiment in relation to plant responses to light.

C. Specific Environmental Education Teaching Competencies (continued)

23. The teacher will be able to help children make inferences about the effect of changing the amount of light on plants outdoors.
24. The teacher will be able to help children conduct a controlled experiment in relation to plant responses to temperature.
25. The teacher will be able to help children construct a new terrarium providing optimum ranges of environmental factors for the organisms studied.
26. The teacher will be able to help children to conduct a controlled experiment to determine the feeding relationships of herbivore such as Daphnia.
27. The teacher will be able to help children to conduct a controlled experiment to determine the feeding relationships of carnivore such as chameleons.
28. The teacher will be able to help children to identify interacting populations in aquaria and terraria.
29. The teacher will be able to help children to make inferences about food chain and food web relationships in nature.
30. The teacher will be able to help children to illustrate predator and prey relationships.
31. The teacher will be able to help children to develop an operational definition of the term community.

Classroom Unit Implementation

Providing assistance to the teachers in implementing their teaching of the SCIS Units was also a responsibility of the EEC representatives. Planning the teaching-learning activities and discussing the results of the lessons were

an integral part of each competency training module. Other types of assistance included: responding to questions about SCIS materials, expediting shipment of equipment from Rand McNally and Company, replacing shipments of live materials and monitoring conditions and progress of classroom experiments.

Overall, an attempt was made to minimize teacher dependence on EEC representatives and to maximize teacher competency as a direct result of his participation in the environmental education CBTEP training modules. This approach was designed to be consistent with both the nature of the CBTEP modules and SCIS instruction roles. The latter were described by Thomson and Voelker[14] in the following way:

> The units are structured in such a way that children are to have (1) first-hand experiences (2) a laboratory setting, and (3) be able to explore natural phenomena in small groups or individually, depending upon the activity. The developers believe that the teacher should provide substantial guidance and help with discussion. Thus, the development of erroneous ideas is circumvented. The teacher should then provide opportunities for children to extend their learnings by applying those concepts with which they were working in a new context. The materials are structured in such a way that the teacher is provided with equipment and suggestions for the extension of these concepts. It is imperative with a program such as SCIS that the teachers assume a role of guide instead of the more conventional information giver. This aspect of teacher behavior becomes of prime importance if the program is to be successful.

Summary

During Spring Semester 1973, selected classroom teachers in cooperating New York City schools were given CBTEP training in environmental science education as part of the CUNY CBTEP EEC Field Project. Competency training was organized into modules and conducted at four CUNY colleges and cooperating schools by means of informal sessions. Materials related to the SCIS Life Science Units were utilized in each competency training module. CBTEP training modules were designed for competency development in three areas

of environmental education: a. General Teacher Competencies; b. Specific Teacher Competencies; and c. Specific Teaching Competencies. As part of the Field Projects the selected teachers were provided with SCIS Life Science materials for use in their classrooms. EEC representatives monitored and provided assistance to the teachers as they demonstrated their competencies in teaching the Unit.

## EVALUATION, RECOMMENDATIONS AND SUMMARY

### Introduction

This section of the report discusses evaluation, recommendations and summary of The City University of New York Office of Teacher Education Competency-Based Teacher Education Field Project in Environmental Education. The Field Project was conducted during the Spring Semester, 1973 as part of a feasibility study begun in January 1972 by the Science Education Committee of The City University of New York Competency-Based Teacher Education Program (CUNY CBTEP). A working group, the Environmental Education Committee (EEC), was formed from the CUNY CBTEP Science Education Committee for the 1972-1973 academic year to write statements of elementary school teacher science education competencies in the content area of environmental education and to field trial teacher training in the stated competencies.

EEC representatives at four CUNY Senior Colleges, (Lehman, Richmond, The City College and York), developed and coordinated the CBTEP field projects. The CBTEP projects involved writing environmental education competency lists; designing competency training modules for third, fourth, fifth and sixth grade level teachers, selecting cooperating schools and teachers, conducting module training sessions with the teachers at the Colleges and the cooperating schools; assisting the cooperating school teachers in demonstrating their environmental education teaching competencies via Science Curriculum Improvement Study (SCIS) Life Science Unit instruction in the classrooms; and providing data to the CUNY CBTEP EEC on the operation of the Field Project. Background information on development of the CBTEP Environmental Education Project and a description of the CUNY CBTEP EEC Project are presented in the Introduction and The Field Project

sections of this Report. The present section is organized into the following major divisions: Evaluation, Recommendations and Summary.

## EVALUATION

Evaluative information appearing in sections on Classroom Observations, Teacher Anecdotal Records, Children's Art and Written Work, Administrators' Evaluations and the Teacher's Self-Report Rating Scale was gathered in an inservice teacher training program conducted over a relatively brief time span. Evidence was sought for observable teacher competency behaviors rather than pupil outcomes associated with teacher behavior.[15] EEC members, administrators and cooperating teachers documented competency behaviors the training modules were designed to produce. The evaluative phases of the EEC Field Projects conform with Criterion Level Three of Turner's Six Criterion Levels for CBTEP confirmatory feedback systems.[16] This criterion level differs from criterion levels 1 and 2 in that pupil performance data are eliminated from the criterion. Judgements about competence or proficiency are thus based on the observable behaviors of the teacher rather than on pupil outcomes associated with these behaviors. Nonetheless, this criterion level is still performance-based in the sense that the teacher actually does engage in teaching and is gauged on the quality of his professional actions. The suitability of this level for measuring association among teacher-pupil behaviors can be seen by examining the Six Level Criterion hierarchy.

Data for studying the EEC Field Projects were gathered from the following areas: development and use of the environmental education competency training modules; cooperating teachers' participation in competency training; and teachers' application of competency training to elementary school classroom work of the SCIS Life Science Unit. Discussion of these data is organized

into the following subsections:

Teacher Characteristics

Competency Training Modules

Classroom Observations

Teacher Anecdotal Records

Children's Art and Written Work

Administrator's Evaluation

Teacher Self-Report Rating Scale

Conclusions

Teacher Characteristics

To record whatever growth the five classroom teachers perceived themselves to have undergone and to obtain their profiles with regard to certain characteristics, the Maben[17] National Science Teaching Study, Survey of Science Teaching in Public Elementary Schools, Elementary Teacher Questionnaire, given in Appendix A,was administered. Basic background information was obtained about the cooperating teachers which could be compared with national data. Selected characteristics of the teachers are presented in Table 1, p. 29. It is of interest to note that about one-third or more of National Study teacher respondents had more than ten year's experience teaching elementary school science; about one-fourth held Masters Degrees; and approximately one-fourth had graduate credit in science or science education. In the National Study, graduate degrees and graduate credit hours in science and science education were found to be associated with elementary school enrollment size. This was also true of inservice participation by respondents in science related teachers' meetings, curriculum revision, courses and workshops since September, 1968. The EEC teachers indicated minimal participation in these science education inservice activities.

TABLE 1

SELECTED CHARACTERISTICS OF EEC COOPERATING TEACHERS

COLLEGE CENTERS

| Characteristics | Richmond College | | York College | City College | Lehman College |
|---|---|---|---|---|---|
| | Teacher A (Female) | Teacher B (Female) | Teacher C (Male) | Teacher D (Male) | Teacher E (Female) |
| 1. Years teaching | 15 | 3 | 1 | 5 | 20 |
| 2. Number of Undergraduate hours in science and science education | 14 | 18 | 66 | 29 | 15 |
| 3. Number of graduate hours in science and science education | 0 | 4 | 23 | 6 | 9 |
| 4. Number of years teaching science in an elementary school | 3 | 12 | 1 | 2 | 10 |
| 5. Degrees held | B.S. Elem. Educ. | B.A. Sociol-ogy | B.A. Biol-ogy | B.S. Educ. | B.A. Psychol-ogy |
| | M.S. Elem. Educ. | M.S. Elem. Educ. | M.S. Gen. Science | M.S. Reading | M.S. Educ. |
| 6. Currently working on a formal degree program | - | Sixth Year Certif. in Educ. Admin. | - | - | - |
| 7. Attendance at any science inservice activities | In 1969, College Sponsored | - | - | - | - |
| 8. Previous teaching of science course improvement projects | None | None | None | None | None |

Of great concern to teachers of elementary science are the many barriers they perceive frustrating their teaching efforts. Nationally, a majority, over 75 per cent for some items, reported these impediments to effective teaching. Many of the same difficulties EEC cooperating teachers were facing in their classrooms are reported below in Table 2.

TABLE 2

BARRIERS TO EFFECTIVE TEACHING OF ELEMENTARY SCIENCE

COLLEGE CENTERS

| Factors | Richmond College | | York College | City College | Lehman College |
|---|---|---|---|---|---|
| | Teacher A (Female) | Teacher B (Female) | Teacher C (Male) | Teacher D (Male) | Teacher E (Female) |
| 1. Inadequate room facilities | - | - | none above 2 | - | 3 |
| 2. Lack of Supplies and Equipment | 3 | 3 | - | - | 3 |
| 3. Insufficient funds for equipment, materials and supplies | 3 | 3 | - | 3 | 3 |
| 4. Inability of teachers to improvise materials and equipment | - | - | - | 3 | - |
| 5. Teachers do not know methods for teaching science | - | - | - | - | 3 |
| 6. What science to teach in each grade has not been clearly determined | - | - | - | - | 3 |
| 7. School believes other areas more important than science | - | - | - | - | 3 |
| 8. Not enough time to teach science | - | - | - | - | - |
| 9. Availability of Supplies | 2 | 2 | 1 | 1 | 2 |
| 10. Availability of Equipment | 3 | 3 | 1 | 2 | 2 |
| Note: 1 - No difficulty<br>2 - Some difficulty<br>3 - Great difficulty | | | | | |

Competency Training Modules

At Lehman College, twelve Environmental Education Competency-Based Teacher Education Program (CBTEP) Training Modules directed toward teacher achievement of stated competencies were designed and used to train the teacher; with Richmond College seven training modules were designed and used; with The City College fourteen were designed and used; and with York College twelve were designed and used. As discussed above, pp. 13-16, the training modules were conducted utilizing inquiry teaching techniques. Teachers were encouraged to raise questions, to identify problems and to construct mental models to explain and integrate observed environmental phenomena.

Module learning sessions were directed toward teacher competency in environmental scientific knowledge, science processes and science teaching. Time spent on modules varied according to competency levels to be achieved and teacher progress. Teacher progress through training modules was consistently successful in knowledge, process and teaching competencies as indicated by teacher feedback and evaluative comments from EEC representatives.

Teacher comments were positive regarding what was learned, the resource materials provided, and the value of competency training. This was particularly evident in relation to what teachers reported about their pupils' learning and motivation.

A number of questions were raised by teachers during competency training modules including scheduling constraints, culturing live materials; background life science information; and safety and/or durability of the SCIS equipment. Occasionally, other teachers asked to borrow equipment or materials used in the modules for use in their own classrooms as well as to obtain copies of reference materials for use as teaching resources.

Classroom Observations

During the term of the Field Project, EEC representatives visited the cooperating school classrooms a number of times to observe teaching of SCIS Life Science Unit lessons. The major purpose was to observe the extent to which teachers demonstrated competencies which the training modules were designed to develop. Observations of the lessons provided data on: a. General teacher environmental education competencies; b. Specific teacher competencies in environmental education; and c. Specific environmental education teaching competencies. A listing of these competencies is given on pp. 18-23. The EEC sought qualitative data on whether or not the stated competencies could be designed into modules and subsequently observed in the classroom. It is to be emphasized that the emphasis of the CBTEP EEC Project was on competency training of the teachers and not on measurement of pupil achievement.[16] It was observed that in all three of the cooperating teachers' lessons, stated competencies appropriate to children's activity, learning goals and the teaching situation were demonstrated by the teachers. The following are generalized observations about the teachers' competency levels as demonstrated during the three visitations:

The teachers showed enthusiasm, confidence and interest.

The teachers seemed to be developing a logical plan toward specific objectives.

The teachers were using correct scientific terminology.

Work proceeded from concrete objects and observational facts to introduction of semi-abstract and abstract inferences.

The teachers provided for individual differences.

Independent activities appeared interesting, meaningful, and scientifically correct.

Children seemed enthusiastic about the science program.

Pictures, real objects and first-hand investigations were being used as teaching tools.

Pupils' questions were answered with analytical questions.

The teachers utilized discovery techniques rather than rules to help children solve problems.

When new concepts were introduced the teachers encouraged children to look for examples in everyday life.

Classroom atmosphere encouraged discussion of problems and various ways of interpreting the problem situations and the environmental science involved.

Earlier and advanced supplementary books were available to students for reference.

In evaluating children's problem solving, the teachers evaluated critical thinking as well as correct answers.

The teachers encouraged children who had discovered ideas beyond the planned lessons to share them and to explain these concepts to the class.

Teacher Anecdotal Records

Anecdotal records of the SCIS Life Science Unit lessons were recorded by the cooperating teachers and were discussed with the EEC representatives. Statements from their anecdotal records and from the records kept by the children have been selected to illustrate the type of observations made by the teachers and the competencies associated with the classroom learning activities. In the following anecdotal record excerpts, names of children have been replaced by an anonymous first letter and the sex of the children, indicated by the second letter, F or M. Anecdotal selections have been organized for the third, fourth, fifth and sixth grades into three categories: 1. early in the Life Science Unit; 2. the middle of the Unit; and 3. the last part of the Unit. Teacher anecdotal record excerpts from early in the Life Science Unit for grade three are given below:

> Many children from other classrooms have been walking in and out of the room to explore the umbrella-shaped light and the experiment table. My children discuss their experiments with them.

When I used the wrong planter, the one without holes in the bottom, I.F. discovered my problem immediately. When I said I was a "dumb-dumb," several children said, "No! Everyone makes mistakes."

On our "scientific expedition to a Bronx park," L.F. pulled a leaf off a tree. There was immediate reaction from the class, "You're ruining property!" Many children admired a neighborhood lawn. Several discovered mold on a tree branch. Finding a worm brought great excitement. N.M. put a worm in my face. E.M. went around killing worms and insects. Snails were discovered near polluted water. Police warned children about rats.

Anecdotal statements which reflect the third grade cooperating teacher's classroom observation during the middle period of the Life Science Unit are excerpted below:

R.F. and a few others decided green leaves are turning brown because of intense heat from the umbrella light.

Shipment has arrived. Kids are concerned that I open it properly and not injure anything.

When chameleons were placed in the terrarium they immediately began devouring the crickets. Immediate shrieks of horror. They were rather concerned that all the crickets would be consumed in this fashion. When they were told organisms, as a rule, only eat when hungry and only man kills unnecessarily, R.M. exclaimed, "I never killed anyone!" to which another boy confirmed the same was true for him. Crickets were observed walking on a lizard. By the end of the afternoon several of the children refused to go home because they wanted to take the terrarium home. Q.M. kept hugging the box and said he would love and care for his chameleon like it was his little brother.

Sixth grade boys, who deliver school items to my room, automatically go around the room to examine specimens and to check growth changes.

Anecdotal records were continued by the third grade cooperating teacher until the end of the Life Science Unit. The following are excerpts from her records for the last part of the classroom study of life science.

A sixth grader brought a land snail for us to hold for him. Also, his younger brother gave us six snails to have. We had to get a book to distinguish land and water snails.

Excitement developed when one of our chameleons shed his skin.

C.F. brought a chameleon to my attention because it was acting strangely. The chameleon proceeded to go through its "death dance." F.F. took the chameleon in her hands after refusing to accept its death. Q.F. was convinced that rigor mortis had already set in, but F.F. insisted that she saw its eyes flexing. It was agreed that she would try to give it warmth by cupping it in her hands. After an interval it was agreed that death had claimed it.

The children have become so talented. Before nine a.m. and again at three p.m. many come in with jars full of many different kinds of insects. They spend many hours observing them in their surroundings. At times they develop a liking for certain insects and refuse to feed them to the chameleons. Daddy-long legs are a favorite. They have even caught wasps and bees. Books were gotten to describe different insects and their characteristics. At times they would play with insects on the floor.

Children from other rooms always wandered in. Visitors always were greeted with chameleons ready to be placed on their persons. Not all visitors were willing to touch or have them put on them.

Excerpts of teachers' anecdotal records of their own reactions and those of fourth grade pupils early in the Life Science Unit are given below:

Today our group watered the seeds. We didn't see anything growing. Maybe in a few days we will see something growing. But for now, we will just have to water the seeds and wait for them to grow.

I was never so aware of living things. Beetles, isopods, snails were all taken for granted. The children are very excited. They are working together nicely. They set up groups and gave themselves names--the green sprouts, the green thumbs, the blooming four, the popping plants, the germinators. They are very interested and are working well.

When the snail excretes it affects the environment by polluting it. The other animals may be eating the excrete.

Today we watched the snails go over each other. I expect some of the other insects to die. Why? Because we really don't have enough green plants in the terrarium.

Excerpts of anecdotal records made by cooperating teachers in two fourth grade classes from the middle period of the Life Science Unit are given below:

> It's amazing how dependent living things are on each other. And I think the children realize it and how dependent each person is upon the other. The children are eager and willing to do research, they're looking up new words. It's working very well. I'm very pleased. I'm not telling them, they're doing it by themselves.
>
> There are some discipline problems. My class is slow--some have emotional problems. They are below grade in reading. But most are responding positively. They like it. I do too--but two boys were destructive. After things were set up they destroyed it. I'm learning a lot too--how things affect each other and how children can work together.
>
> The children are really interested. They are planting things on their own--making their own experiments, finding out on their own. They have the freedom to talk. It allows them to become verbal. It allows them to move. It gives them freedom to think.

An excerpt of a fourth grade teacher's record of observation during the last period revealed the following:

> Feeling and touching the animals was important. They developed positive attitudes toward animals. It encouraged uses of new vocabulary. It extended into other areas--water--the graphs, number concepts. They made poems about them--wrote stories. It fit in with our unit in family living.

Excerpts from the record kept by a fifth grade child and the cooperating teacher concerned a field trip to a grassy area during the early period of the Unit. The children explored and observed and then listed many things they had never really noticed before. The following is the written record of this experience:

> Our First Field Trip. We went to the park. We saw kids on the edges of the tree. There were no leaves on it. We saw no leaves. We saw balls on the trees. The weather was first raining then the sun came out. We saw birds and a lot of grass on the rocks. The rocks were shining. We saw branches without leaves. We saw dried ferns on branches. We saw a rusty worm. We saw a cockroach. I saw a mouse. We saw writings on the tree branch. I saw an ant. We saw a strange kind of tree, it is a kind of a vine tree. I saw a strange bud. I saw a tree that had yellow flowers. I saw another

worm, it was alive in the soil. We saw an earthworm was cold. Then we saw another tribe of worms. I saw berries on the grass. We saw caterpillar. I saw sand on the ground, it was dirty. We saw a worm cut in half. We saw a helicopter almost near the ground, it almost touched it. It was a nice and fun trip.

M.F.

From the teacher:

The children wrote their notes of what they observed on the field trip and then discussed and compared their observations. They were surprised that they did not all observe the same things. The children were very interested and many contributed to the discussion.

The following excerpts from the teacher's record were taken from the middle period of the Unit:

April 30, 1973-The ice chest arrived during the week after the recess and today the children began setting up the terraria. Four to five children joined each group and were very excited about handling the living animals. Some of the children found handling the crawling insects a problem but there was a great deal of cooperation. They asked questions about how much soil, how much water and whether to put them in the sun or not.

The following is an account of the fifth grade class progress in learning about the environment. It was printed on a poster and placed at the School Science Fair where the class exhibited two terraria as its contribution to knowledge about the environment. The account is representative of the activities that took place during the last period of the Unit.

<u>How Plant and Insect Life Thrive in a Good Environment</u>

We learned the hard way. Our first terrarium molded because we put in too much water in it. This one is our second and is about two weeks old. We planted beans, clover and grass seed. It grew in one week. It is beautiful. The beans are tall and green. The clover is half grown and also green. The grass is very tall. Our insects almost all died. We started with five mealworms, six beetles, six isopods and six snails. Now we have two worms, one beetle and no isopods and still six snails. The dead insects enrich the soil. The environment is great.

N.F. M.F.
C.F. L.F.

It is informative at this point, rather than continue to report on teacher and pupil satisfaction in exploration, discovery, invention and reinforcement, to indicate certain criticism that was raised. Several of the most significantly critical comments the sixth grade cooperating teacher provided during the course of the training sessions were:

During the early period·

The instructions given by SCIS for the children were not clear. There was need for ditto sheets with more explicit instructions.

During the middle period:

It is difficult to carry out this program in an intermediate school because of an inflexible time schedule.

I need a book to fill in while waiting for the seeds to grow.

I used many filmstrips to fill in the gaps.

During the last period:

Christmas and Easter should be taken into account in daily planning because the seeds and animals die then.

Although investigation into the linkage between pupil learning and teacher performance was not an objective of the project, the following comments of pupils are most illuminating for the lesson they teach in the failure to develop, at least for the sixth grade class selected, any degree of pupil understanding of the processes and relationships being taught by the SCIS "Ecosystems" Unit. The following comments of pupils illustrate clearly this failure of the teaching-learning process within the time frame of the EEC training project:

The snail floats because it has air in its shell.

The algae are probably growing because we haven't cleaned the tank out much."

Probably only one seed grew because the others died by flooding.

Children's Art and Written Work

The cooperating teachers took advantage of many learning opportunities during the units to strengthen language arts related science process skills and art related science process skills. A wide range of these content integration type activities were arranged as children labeled their individual and small group materials and experiments; made observational statements about their own plants, aphida, aquaria etc.; summarized findings of total class,

individual or exploration group experiences; and expressed what they had learned from school neighborhood field trips, invention lessons or group discussions.

Teacher competency in this aspect of integration has been considered of great importance in New York City schools. In some of the cooperating classrooms the average achievement in language arts was two years below grade level. Therefore, illustrations of competence in environmental education teaching that strengthened language arts and other content area related science process skills attracted particular attention during the Field Project.

Review of the cooperating teachers' anecdotal records, pp. 33-38 above, for the early, middle and last parts of the unit, can reveal ways in which speaking, writing, listening, observing, discussing, reading, inferring, predicting, labeling, charting, drawing, etc. were an integral part of the environmental education Units.

Administrator's Evaluation

Evaluation conferences were held with the four principals. A summary of their comments are given below:

> The competency-based project was highly successful and further university-school cooperative programs would be welcomed.
>
> Stimulus in environmental education was provided to the entire school because of the project.
>
> The ability of children in the cooperating class to express themselves concerning their work and their interest in environmental education were very high and showed great personal growth.
>
> Vocabulary enrichment was especially noticeable.
>
> The use of varied reading materials was markedly increased.

Student activity and materials in the classroom provided visible evidence of purposeful inquiry and learning.

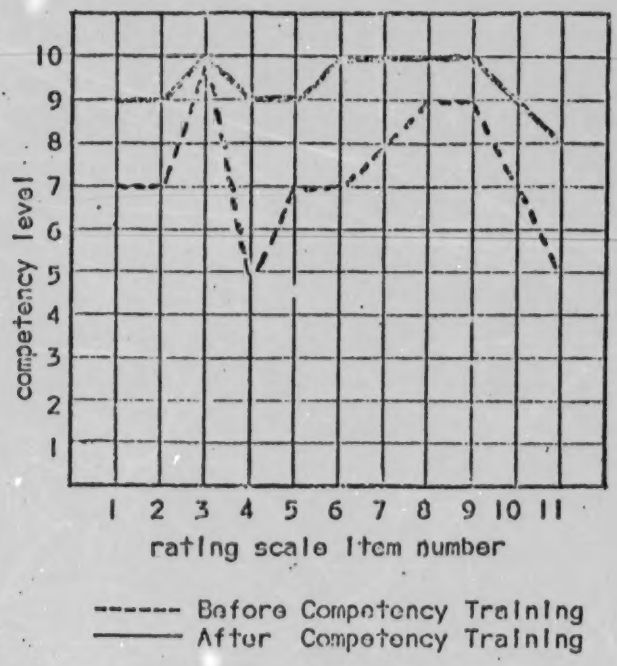
Teacher Self-Report Rating Scale

The Environmental Education Committee (EEC) decided that a rating scale on the desired Environmental Education Competencies administered to cooperating teachers would provide data on how much Field Project teachers felt they had increased their competencies as a result of EEC Project involvement. Richmond EEC representatives developed a self-report rating scale to be administered at the end of the Field Project. This instrument, "Evaluation of Teacher Objectives for Environment Unit," is shown in Appendix B. The rating scale is divided into three sections: Part I, General Teacher Competencies; Part II, Specific Teacher Competencies in Environmental Education; and Part III, Specific Environmental Education Teaching Competencies.

The self-report rating scale was administered after the completion of the final Competency Training Module. The cooperating teachers were directed to mark on a scale from one to ten, one indicating low and ten high, what they felt their level of competence was for each listed competency at the beginning, using an "O" and at the end, using an "X".

Cooperating Teacher E responses on the "Evaluation of Teacher Objectives for Environment Unit" rating scale are shown graphically for Part I, General Teacher Competencies, Part II, Specific Teacher Competencies in Environmental Education and Part III, Specific Environmental Teaching Competencies, on pages 41 and 42. Responses for cooperating Teachers A, B, C, D are shown graphically in Appendix B, pp. 68-73 and pp. 80-81.

TEACHER RESPONSES ON PART 1: TEACHER E




TEACHER RESPONSES ON PART II:
SPECIFIC TEACHER COMPETENCIES IN ENVIRONMENTAL EDUCATION

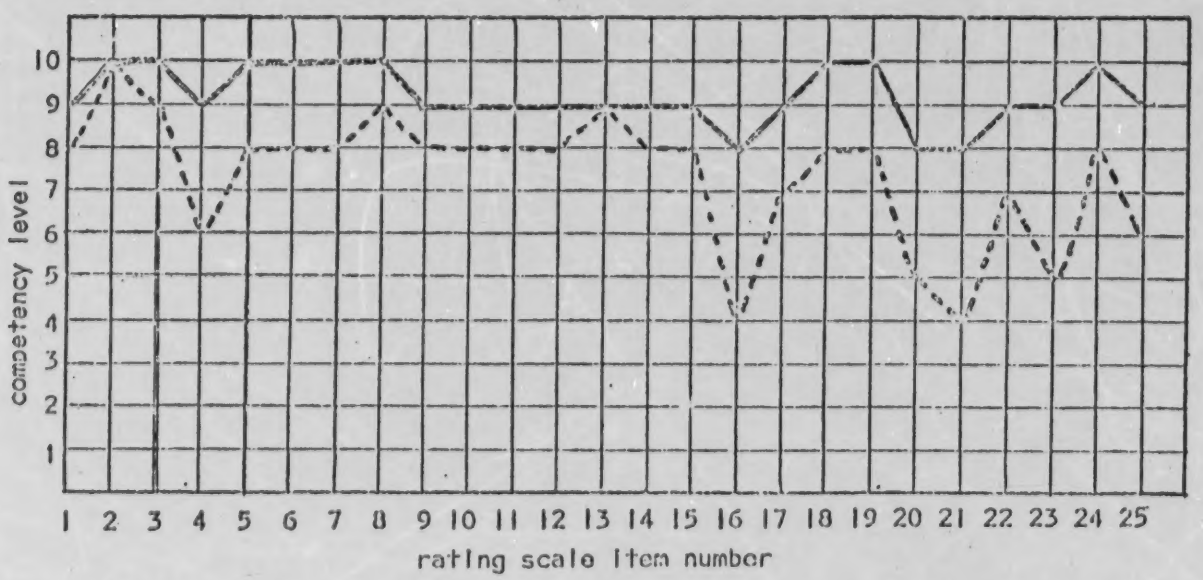
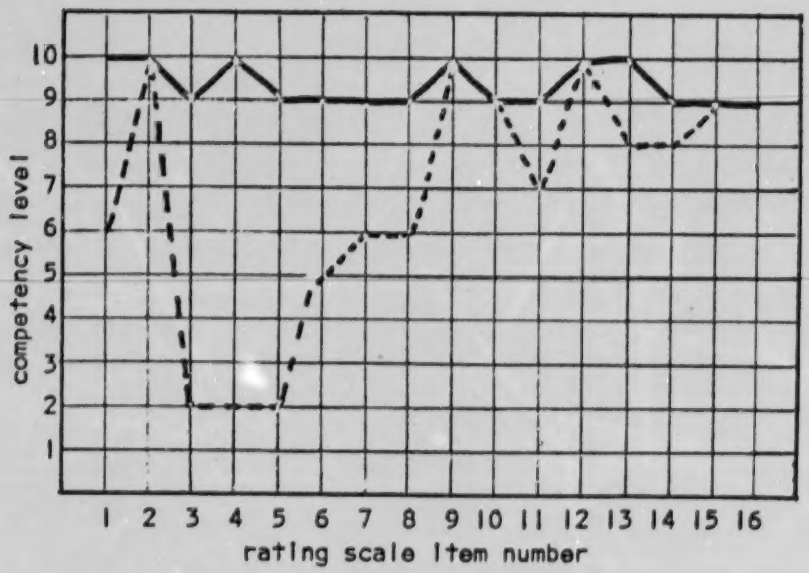



FIGURE 1

TEACHER RESPONSES ON PART III: TEACHER E
SPECIFIC ENVIRONMENTAL EDUCATION TEACHING COMPETENCIES



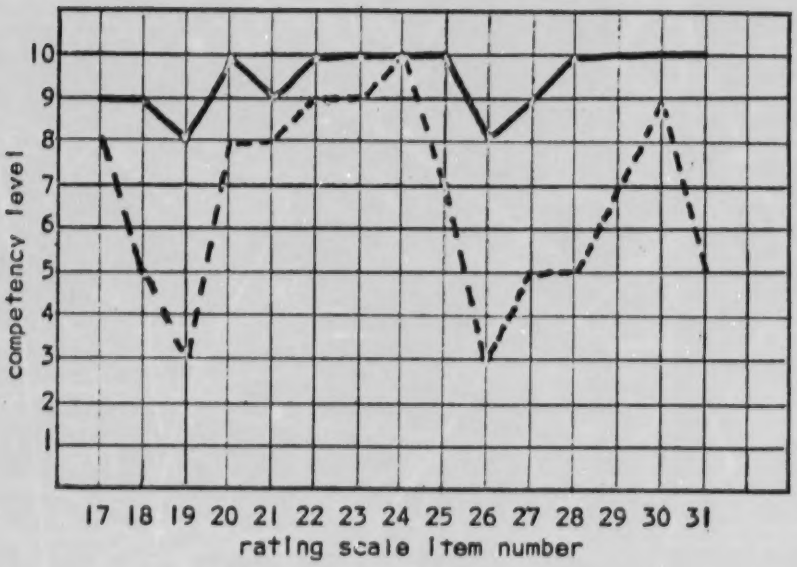




FIGURE 1, Cont.

## Conclusions

Data were obtained for the CUNY CBTEP Environmental Education Committee (EEC) in relation to three aspects of the Project: a. operation of the environmental education Competency Training Modules; b. the cooperating teacher's participation in the competency training Project; and c. the teachers' demonstrated competencies as they conducted the SCIS Life Science Units in their classrooms. The following were used for data gathering purposes: the Maben Elementary Teacher Questionnaire; teacher and instructor feedback on the Competency Training Modules; observations in the classrooms; teacher anecdotal records; children's art and written work; evaluations by the principals of the cooperating schools; and the modified Richmond Evaluation of Teacher Objectives for Environment Unit Self-Report Rating Scale.

# RECOMMENDATIONS

As a result of The City University of New York Field Project in CBTEP Environmental Education, the following specific recommendations are made regarding: 1. Competency Training Modules; 2. CBTEP Field Projects and 3. CBTEP Preservice Training.

## Competency Training Modules

Recommendations for further research and development of Training Modules for competency-based teacher education in environmental education include:

A. Science process skills should be emphasized in each Module.

B. Module laboratory experiences with college and elementary school science education materials should be continued.

C. Quantitative Module evaluation methods should be employed at appropriate Module program stages.

D. Present pilot Modules should be redesigned based on revised Competency Lists.

E. Revised Modules should have provision for self-testing of learner competency strengths at entry points, during training and at exit points.

F. Auto-tutorial methods such as computerization and programming should be used in the Modules.

G. Trainers should make extensive use of videotape recordings, audio recordings and motion picture films of teachers working with classroom children, and test for the effectiveness of these treatments.

H. Modules should include group as well as individual learning procedures.

CBTEP Field Projects

Recommendations concerning CBTEP Field Projects for investigative, trial and demonstration aspects of Competency-Based Teacher Education include:

A. Field trial and investigation of EEC competency-based teacher education products should continue to be implemented.

B. Close relationships between Training Modules and practical competency field work should be maintained and extended.

C. University-School Cooperative CBTEP Projects which are directed toward mutual goals should be encouraged.

D. Teacher, administrator and CBTEP instructor self analysis data should be considered for inclusion in Field Project evaluation procedures.

CBTEP Preservice Training

From the experiences gained from having used CBTEP Competency Training Modules with inservice experienced teachers, the following recommendations are made for preservice CBTEP elementary school science education:

A. Competency Training Modules developed for the four CUNY Field Projects should be adopted for investigative CBTEP use with preservice teachers.

B. New Preservice CBTEP Modules should be developed for training in the achievement of the same types of competency objectives as Project Modules.

C. Preservice Competency Modules should utilize audio tape recording, video-tape recording and on-site observation of varied CBTEP teaching models.

D. Field experience opportunities should be considered for inclusion in Modules for preservice teachers to develop and demonstrate science education teaching competencies.

E. Preservice CBTEP Modules should contain large group, small and individualized learning and teaching experiences.

F. A wide range of both college level and elementary school level science education materials should be considered for use in CBTEP Modules.

G. Science Course Improvement Project materials and other widely accepted curriculum materials as well as innovative and experimental materials should be evaluated for inclusion in Preservice Modules.

H. CBTEP Preservice Modules should be considered for existing teacher education science courses.

I. Preservice and Field Project CBTEP Modules should be investigated for potential CBTEP training of inservice elementary school teachers in science education competencies.

## SUMMARY

During Spring Semester 1973, four senior colleges of The City University of New York established Centers for the Field Project in Competency-Based Teacher Education for Environmental Education. The Field Project was part of a CBTEP feasibility study developed by the CUNY CBTEP Environmental Education Committee. The Committee was formed as a working group of the CUNY CBTEP Science Education Committee which was established in January of 1972. The Project included: a. refinement of an Environmental Education Draft Competencies List in three teacher competency areas - knowledge, processes and teaching; b. design of CBTEP Training Modules which included SCIS materials and learning experiences; c. trial use of CBTEP Modules with inservice teachers in cooperating elementary schools; and d. demonstration of competencies by cooperating teachers through use of the SCIS Units. Evaluation data were provided to the CUNY CBTEP Environmental Education Committee and recommendations were made in regard to CBTEP Training Modules, University-school cooperative CBTEP Field Projects and CBTEP preservice elementary school science education.

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APPENDIX A

MABEN NATIONAL SCIENCE TEACHING STUDY

SURVEY OF SCIENCE TEACHING IN PUBLIC ELEMENTARY SCHOOLS

ELEMENTARY TEACHER QUESTIONNAIRE

SURVEY OF SCIENCE TEACHING IN PUBLIC ELEMENTARY SCHOOLS

ELEMENTARY TEACHER QUESTIONNAIRE

Teacher's Name (Optional) _____

Name of School: _____

Address of School: _____
Number Street

_____
City County

_____
State Zip Code

General Instructions: This questionnaire is to be answered by the individual elementary school science teacher. Please check over the questionnaire to get an idea of the scope of the questions asked before beginning to fill out the form. Check (✓) or fill in every item that applies.

I. TEACHER CHARACTERISTICS

Check (✓) or fill in the blank.

For Item 1, the following definitions apply:

Full-time teachers: those teachers who occupy teaching positions which require them to be on the job on school days, throughout the school year for at least the number of hours the schools in the system are in session.

Part-time teachers: those teachers who occupy teaching positions which require less than full-time service. This includes those teachers employed full time for part of the school year, part-time for all of the school year, and part-time for part of the school year.

Substitute teachers: those persons employed to teach on a day-to-day basis, temporarily replacing regularly employed teachers. They are not considered as part-time teachers in this study. If you are a substitute teacher, please return this questionnaire to your principal.

1. On what basis are you now employed by the school system?
Full-time ☐ Part-time ☐

2. Sex: Male ☐ Female ☐ Age in years: ___

3. a) Number of years of teaching experience in an elementary school (include the present school year): _____

b) Number of years of teaching experience in a secondary school: _____

c) Number of years you have taught any science in an elementary school (include the present school year): _____

d) Number of years at present school system or district (include the present school year): _____

4. Please check the degree(s) you now hold, and specify the major and minor subject matter fields of the degree(s).

| Degrees Held | Subject Matter Fields: Major | Minor(s) |
|---|---|---|
| B.S. or B.A. ☐ | _____ | _____ |
| M.S. or M.A. ☐ | _____ | _____ |
| Ed.D. ☐ | _____ | _____ |
| Ph.D. ☐ | _____ | _____ |
| Specialist ☐ | _____ | _____ |
| Non-degree ☐ | _____ | _____ |
| Other (specify) ☐ _____ | _____ | _____ |

5. Are you now working on a formal degree program? ☐ Yes ☐ No.

If yes, what degree? _____

Major subject matter field _____

Minor subject matter field(s) _____

6. Please specify the number of credits you have in the following areas in either quarter hours or semester hours.

| Undergraduate Work | Quarter Hours | Semester Hours |
|---|---|---|
| Biological Sciences | _____ | _____ |
| Physical Sciences | _____ | _____ |
| Earth Science | _____ | _____ |
| Mathematics | _____ | _____ |
| Science Teaching Methods | _____ | _____ |
| Student Teaching in Science | _____ | _____ |
| **Graduate Work** | | |
| Biological Sciences | _____ | _____ |
| Physical Sciences | _____ | _____ |
| Earth Science | _____ | _____ |
| Mathematics | _____ | _____ |
| Science Teaching Methods or Science Education | _____ | _____ |

7. If you have attended any sponsored science in-service activities since September, 1968, please indicate the year(s) in which you attended the program in the appropriate column below.

| In-service Science Education Activity | Sponsorship: local school level | school system level | state level | national level | college sponsored | any other sponsorship (specify) |
|---|---|---|---|---|---|---|
| Teachers' meetings | | | | | | |
| Curriculum development and revision | | | | | | |
| Elementary science courses | | | | | | |
| Elementary science workshops | | | | | | |
| Visitations and demonstration teaching | | | | | | |
| Television and radio programs | | | | | | |
| Other in-service science education activities (specify) _____ _____ _____ | | | | | | |

8. If you teach or have taught one or more of the science course improvement projects (e.g., ESS, SCIS, AAAS, MINNEMAST, COPES, TSM, IDP, ISCS, ESCP, CSLS), since September, 1968, please supply the following information about each project.

| Science Course Improvement Project | Attendance at Workshop or Institute: Yes | No | Length of Workshop or Institute |
|---|---|---|---|
| _____ | ☐ | ☐ | _____ |
| _____ | ☐ | ☐ | _____ |
| _____ | ☐ | ☐ | _____ |
| _____ | ☐ | ☐ | _____ |

II. SPECIAL SCIENCE FACILITIES AND AUDIO-VISUAL AIDS

1. Check the special science facility or facilities available for your use in teaching science in your elementary school. How much use do you make of each facility that is available?

| Special Science Facility | Availability | | Usage | | |
|---|---|---|---|---|---|
| | Yes | No | Rarely or Never (less than once a month) | Occasionally (about once a month) | Very Often (at least once a week) |
| Auto-tutorial laboratory | ☐ | ☐ | ☐ | ☐ | ☐ |
| Closed circuit television | ☐ | ☐ | ☐ | ☐ | ☐ |
| Computer terminals | ☐ | ☐ | ☐ | ☐ | ☐ |
| Greenhouse | ☐ | ☐ | ☐ | ☐ | ☐ |
| Observatory | ☐ | ☐ | ☐ | ☐ | ☐ |
| Outdoor laboratory | ☐ | ☐ | ☐ | ☐ | ☐ |
| Planetarium | ☐ | ☐ | ☐ | ☐ | ☐ |
| Science darkroom | ☐ | ☐ | ☐ | ☐ | ☐ |
| Science museum | ☐ | ☐ | ☐ | ☐ | ☐ |
| Ventilated animal housing | ☐ | ☐ | ☐ | ☐ | ☐ |
| Weather station | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other (specify) _____ | ☐ | ☐ | ☐ | ☐ | ☐ |
| _____ | | | ☐ | ☐ | ☐ |
| _____ | | | | | |

2. Equipment is defined as non-consumable, non-perishable items, such as microscopes, scales, models, aquariums, etc.

Supplies are defined as perishable or easily breakable materials that must continually be replenished such as chemicals, dry cells, glassware, electric bulbs, copper wire, etc.

To what extent are equipment and supplies for science demonstrations and experiments available in your school (check only one)?

| | Completely Lacking | Inadequate | Adequate |
|---|---|---|---|
| Supplies | ☐ | ☐ | ☐ |
| Equipment | ☐ | ☐ | ☐ |

3. Check the audio-visual aids that are available to you in teaching science. How much use do you make of each kind of aid that is available?

| Audio-Visual Aid | Availability | | Usage | | |
|---|---|---|---|---|---|
| | Yes | No | Rarely or Never (less than once a month) | Occasionally (about once a month) | Very Often (at least once a week) |
| Motion picture projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Filmloop projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Slide projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Overhead projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Opaque projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Micro-projector | ☐ | ☐ | ☐ | ☐ | ☐ |
| Phonograph | ☐ | ☐ | ☐ | ☐ | ☐ |
| Tape-recorder | ☐ | ☐ | ☐ | ☐ | ☐ |
| Television | ☐ | ☐ | ☐ | ☐ | ☐ |
| Commercial models (e.g., molecular, eye, ear models...) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Commercial charts | ☐ | ☐ | ☐ | ☐ | ☐ |

III. MISCELLANEOUS

1. What degree of difficulty do the following factors offer to effective science teaching in your school? Complete all boxes using the following code:
   3 - Great Difficulty
   2 - Some Difficulty
   1 - No Difficulty

| Factors | Degree |
|---|---|
| Inadequate room facilities | ___ |
| Lack of supplies and equipment | ___ |
| Insufficient funds for purchasing needed supplies, equipment, and appropriate science reading materials | ___ |
| Lack of community support for science program | ___ |
| Inability of teachers to improvise materials and equipment | ___ |
| Teachers do not have sufficient science knowledge | ___ |
| Teachers do not know methods for teaching science | ___ |
| Lack of adequate consultant service | ___ |
| Teachers lack interest | ___ |
| What science to teach in each grade has not been clearly determined | ___ |
| School believes other areas more important than science | ___ |
| Not enough time to teach science | ___ |
| Lack of in-service opportunities | ___ |
| Other (Specify) _____ | ___ |
| _____ | ___ |

## IV. ELEMENTARY SCIENCE TEACHING

SPECIAL INSTRUCTION: Section IV, Items 1, 2, 3, 4, 5, and 6 below have been designed to provide information specific to one science class. If you teach only one class of science, such as in a self-contained organization, you may skip directly to item 1 below, and respond to these same items in relation to that class.

*IF YOU TEACH MORE THAN ONE SCIENCE CLASS, PLEASE READ THE FOLLOWING BEFORE YOU BEGIN ITEM 1.*

The method given below is provided for only those elementary teachers who teach more than one group of science students in organizational patterns such as team teaching, ungraded, departmentalization, traveling teacher, etc.

In order to ensure that the elementary school science classes in this survey constitute a random sample, we request your cooperation in selecting one of your science classes, about which we hope to obtain specific information regarding the science teaching practices.

The method of selecting this science class from all your science classes is outlined below. In selecting a science class for the information needed in Section IV, Items 1-6, of the questionnaire, treat each group of students or unit as a separate class.

A) Order your science classes in numerical order, starting with "1" for the first science class that you teach each day, "2" for your second science class, and so on, ending with your last science class for the day.

B) Please select one of the science classes on your list according to the following selection criteria:

Science Class Selection Numbers

05
03
02
01

a) If the total number of science classes that you teach is greater than or equal to 5, select the 5th science class.

b) If the total number of science classes that you teach is less than 5 but greater than or equal to 3, select the 3rd science class.

c) If the total number of science classes that you teach is 2, select the 2nd science class.

1. a) How many students are in *this class*? _____

b) Grade level(s): _____

c) How many times per week do you usually teach science to *this class*? _____

d) How many minutes per week does *this class* usually receive science instruction? _____

2. What pattern of science teaching most aptly describes the approach you use with *this class*?

a) Separate subject ☐

b) Integrated with other subject ☐

c) Incidentally ☐

d) Combinations:
1) Separate subject and incidental ☐
or
2) Integrated and incidental ☐

e) Other (Specify) ☐
_____
_____

3. Which of the following best describes your role as teacher of *this class*?

a) A classroom teacher with no help from an elementary science specialist or consultant ☐

b) A regular classroom teacher who teaches science classes for other teachers ☐

c) A classroom teacher with help of elementary science specialist or consultant who is:

1) on the school staff ☐

2) from central office staff ☐

d) A special science teacher

1) on the school staff ☐

2) from central office staff ☐

e) A classroom teacher who coordinates science instruction with educational television ☐

f) Other (Specify) _____ ☐
_____

4. Please check the kind of room that you use to conduct *this class*.

Laboratory or special science room ☐

Classroom with portable science kits ☐

Classroom with no science facilities or kits ☐

Other (Specify) _____ ☐

5a. Please check the kind(s) of curriculum materials and/or textbooks that you use for *this class*.

- ☐ Single textbook including laboratory manual
- ☐ Single textbook
- ☐ Multiple textbooks including laboratory manuals
- ☐ Multiple textbooks
- ☐ Locally prepared materials
- ☐ Separate laboratory manual
- ☐ Other (Specify) _____ _____

5b. Please supply the following information about the textbook(s) and/or curriculum materials used for *this class*. If space is insufficient, please continue on the back of this sheet or attach a separate list.

| Title | Publisher | Publication Date |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

5c. If you are using materials of any science course improvement project (i.e., SCIS, AAAS, ESS, COPES, IDP, ESCP, etc.) in *this class*, please indicate the materials used and the extent to which they comprise the total science program for *this class*.

| Name of Science Course Improvement Project | Materials Used | | Portion of Science Course for *This Class* | | | |
|---|---|---|---|---|---|---|
| | Printed | Kits | Less than Half | About Half | More than Half | Total Course |
| _____ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| _____ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| _____ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

6. With respect to *this class*, rank the three learning activities that you use most often. Use "1" for the most often used activity, "2" for the next most often, and "3" for the third most often used activity. Mark all other activities which you use with a check (✓).

| | | | |
|---|---|---|---|
| Lecture | ___ | Individual laboratory activity | ___ |
| Lecture-discussion | ___ | Group laboratory activity | ___ |
| Small group discussion | ___ | In-class written assignments | ___ |
| Science demonstrations | ___ | Excursions or field studies | ___ |
| Instructional films | ___ | Programed instruction | ___ |
| Independent study | ___ | Auto-tutorial instruction | ___ |
| Others (Specify) | | Televised instruction | ___ |
| _____ | | | |
| _____ | | | |

7. How satisfied are you with teaching elementary school science?

| | |
|---|---|
| Very satisfied | ☐ |
| Satisfied | ☐ |
| Neutral | ☐ |
| Dissatisfied | ☐ |
| Very dissatisfied | ☐ |

END OF TEACHER'S QUESTIONNAIRE

THANK YOU FOR YOUR COOPERATION

APPENDIX B

EVALUATION OF TEACHER OBJECTIVES FOR ENVIRONMENT UNIT

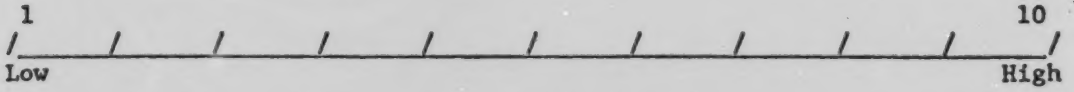
TEACHER RESPONSES ON COMPETENCIES,

PARTS I, II AND III

Evaluation of Teacher Objectives
for Environment Unit
Part I
General Teacher Competencies

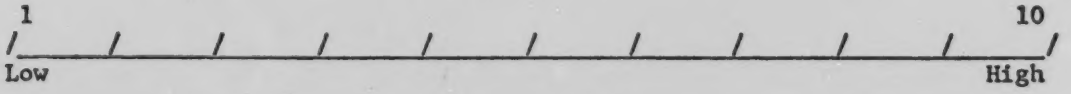
---

1. The teacher will be able to identify the environmental factors which affect living organisms.

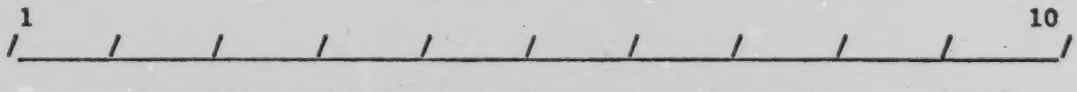



2. The teacher will be able to describe the environments of organisms.

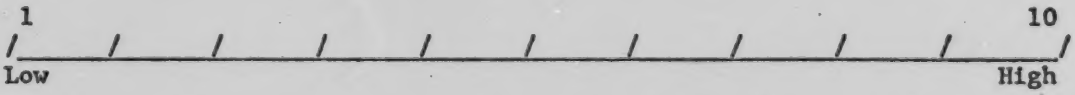
3. The teacher will be able to describe interrelationships between human and other organisms with their environment.



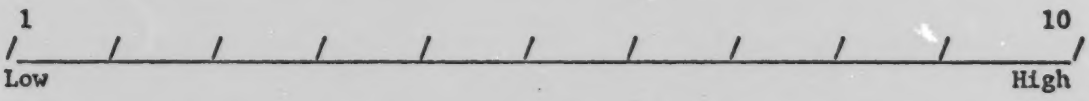

4. The teacher will be able to develop models which evaluate the relationships between changes in organisms and their environment.




5. The teacher will be able to describe the range of environmental factors as it occurs in an experiment or outdoors.



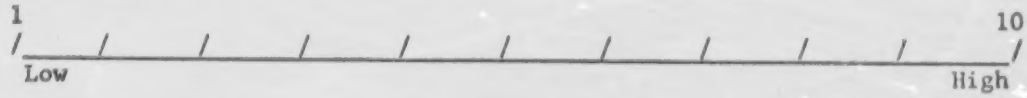

6. The teacher will be able to determine by experiment the best range of an environmental factor for an animal.



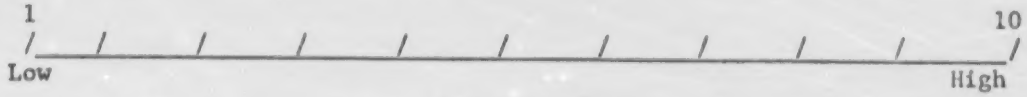

7. The teacher will be able to describe the growth responses of plants under differing environmental conditions.

8. The teacher will be able to determine by experiment the optimum range of several environmental factors for plants.

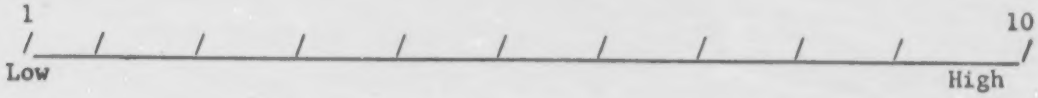
9. The teacher will be able to describe similarities and differences in the responses of plants and animals to changes in environmental factors.




10. The teacher will be able to use experimental data when planning the construction of a terrarium.



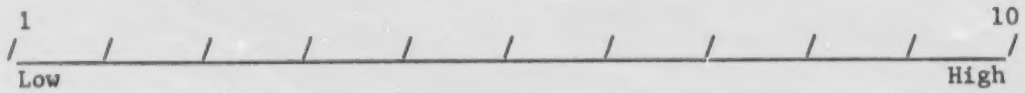

11. The teacher will be able to construct a terrarium providing optimum ranges of some environmental factors.



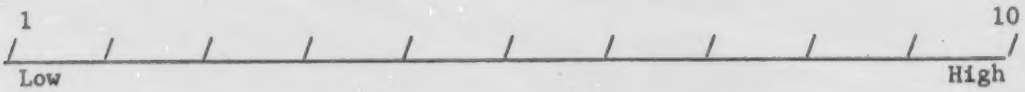
Evaluation of Teaching Objectives
for Environment Unit
Part II
Specific Teacher Competencies in Environmental Education

---

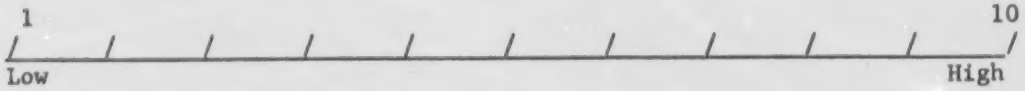
1. The teacher will be able to set up a terrarium.



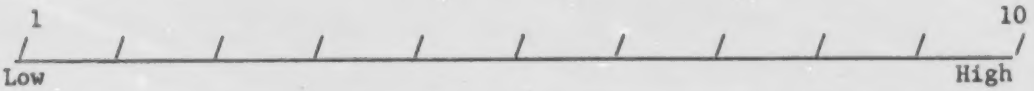

2. The teacher will be able to identify living and non-living objects.



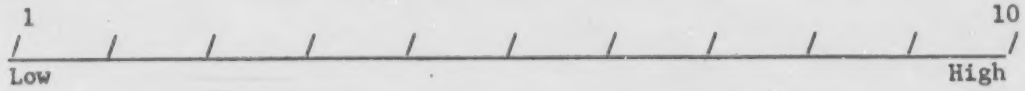

3. The teacher will be able to develop operational definitions of the terms organisms, population and habitat.



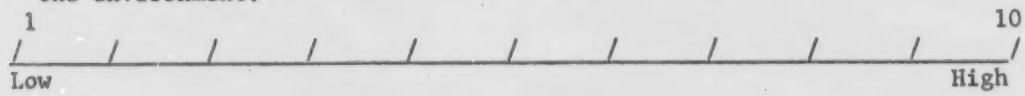

4. The teacher will be able to detect population changes within a specific environment.



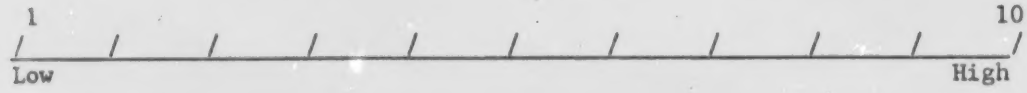

5. The teacher will be able to record changes in the population of a specific environment.



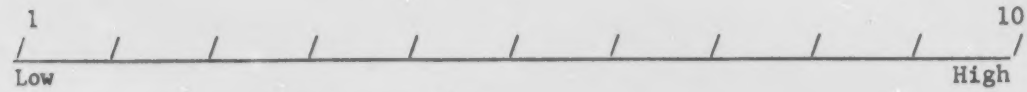

6. The teacher will be able to invent models which describe changes within the environment.




7. The teacher will be able to identify specific environmental factors which affect population changes.

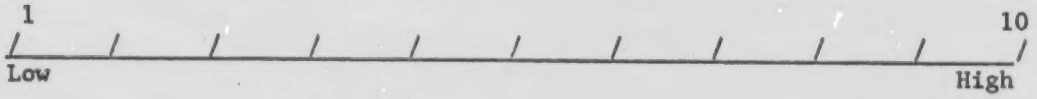



8. The teacher will be able to develop an operational definition of the term environment.

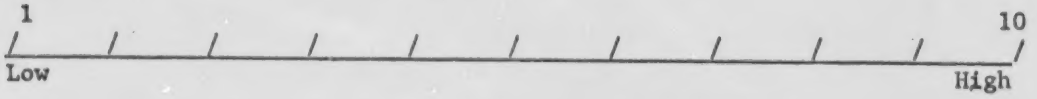


9. The teacher will be able to record observations relative to environment changes such as precipitation and temperature.

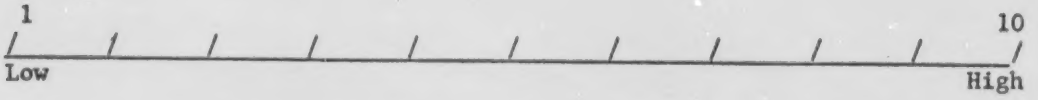
10. The teacher will be able to lead a series of field trips to evaluate living organisms in a particular area.



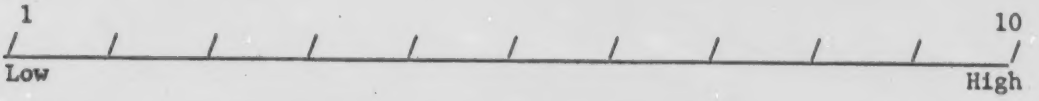

11. The teacher will be able to evaluate the responses of a specific living organism to a variety of temperatures.



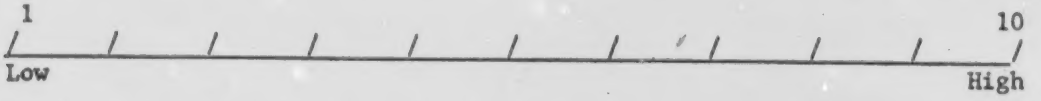

12. The teacher will be able to use observational methods to investigate environmental phenomena.



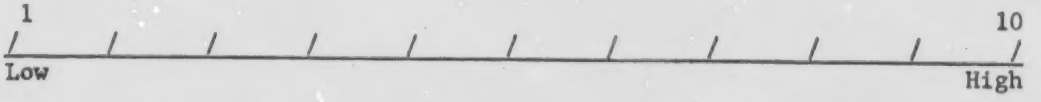

13. The teacher will be able to relate and compare observational data with reference material.



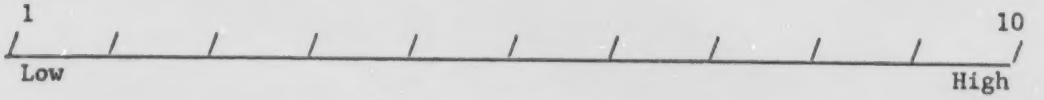

14. The teacher will be able to record environmental data in several ways.



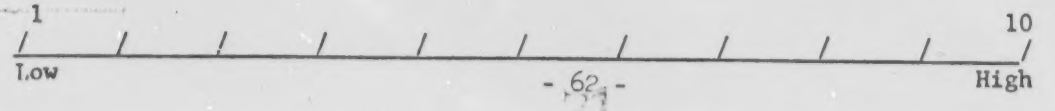

15. The teacher will be able to use recorded data to infer time relationships.




16. The teacher will be able to design an experiment to investigate the salt water environment to hatch shrimp eggs.

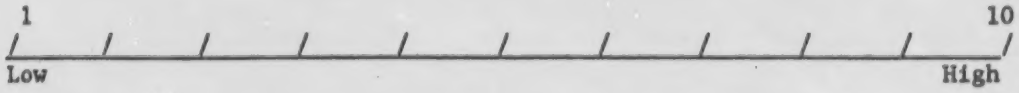



17. The teacher will be able to measure the growth of seedlings and will be able to record the measurements.

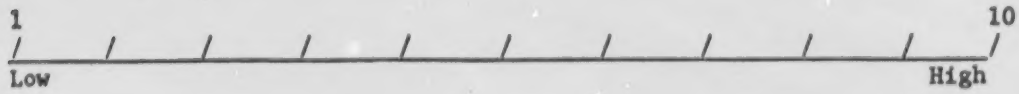


18. The teacher will be able to determine the average growth for each plant.

19. The teacher will be able to conduct a controlled experiment in relation to plant responses to light.

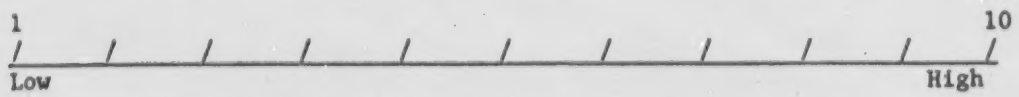



20. The teacher will be able to conduct a controlled experiment to determine the feeding relationships of herbivore such as Daphnia.



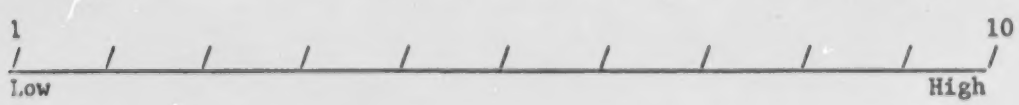

21. The teacher will be able to conduct a controlled experiment to determine the feeding relationships of carnivore such as the chameleon.

22. The teacher will be able to identify interacting populations in aquaria and terraria.

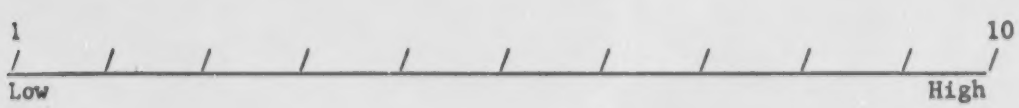



23. The teacher will be able to make inferences about food chain and food web relationships in nature.

24. The teacher will be able to illustrate predator and prey relationships.




25. The teacher will be able to develop an operational definition of the term community.



Evaluation of Teacher Objectives
for Environment Unit
Part III
Specific Environmental Education Teaching Competencies

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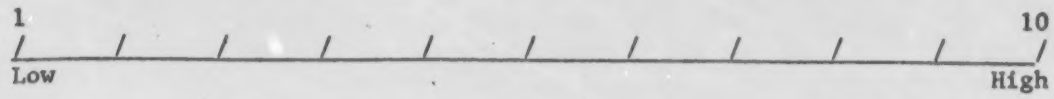
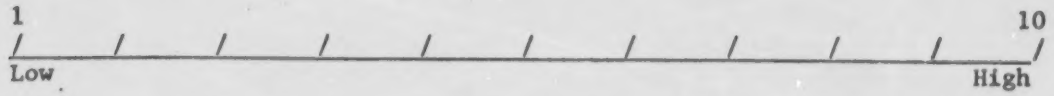
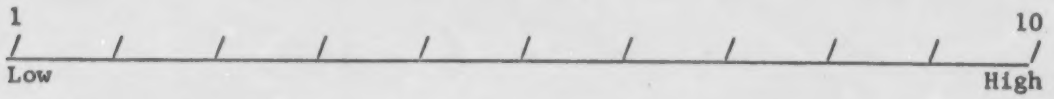
1. The teacher will be able to guide children in setting up terraria.



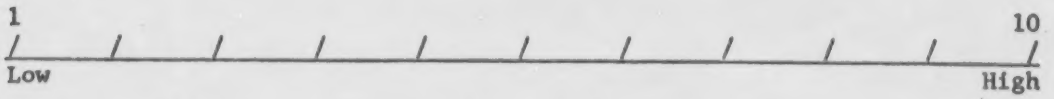

2. The teacher will be able to help the children to distinguish between living and non living objects.



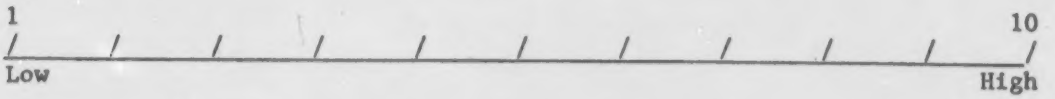

3. The teacher will be able to help the children develop operational definitions of such terms as organisms, population and habitat.



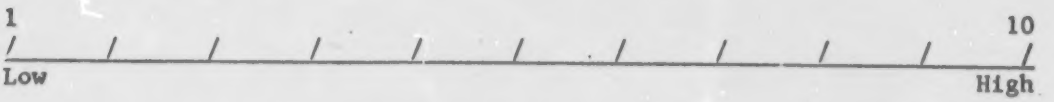

4. The teacher will be able to guide children in detecting population changes within a terrarium.



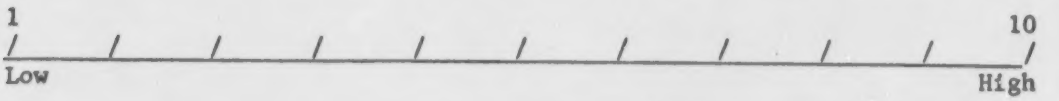

5. The teacher will be able to help children in recording changes in population within a terrarium.



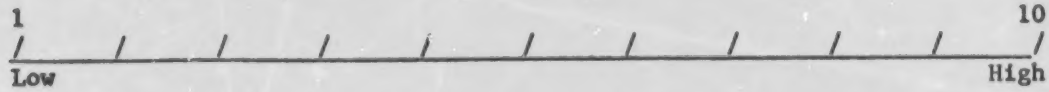

6. The teacher will be able to help children identify specific environmental factors affecting population changes within an aquarium.



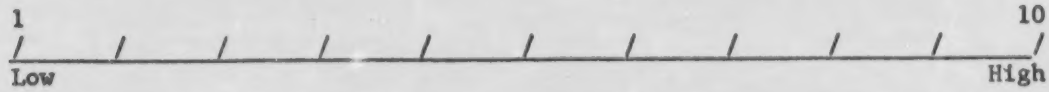

7. The teacher will be able to help children to identify specific environmental factors which affect population changes within a terrarium.



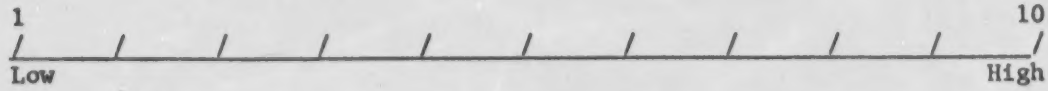
8. The teacher will be able to help the children develop an operational definition of the term environment.



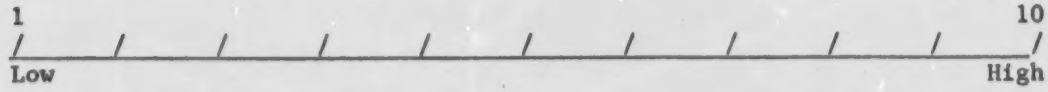

9. The teacher will be able to help children describe interrelationships among humans and other organisms and their environment.



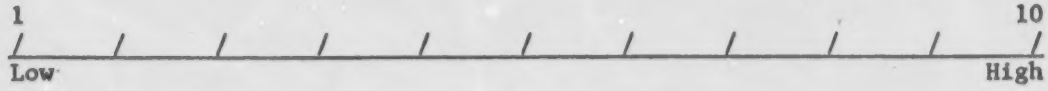

10. The teacher will be able to help children to develop models which evaluate the relationships between changes in organisms and their environment.




11. The teacher will be able to help children record observations relative to environmental changes such as precipitation and temperature.

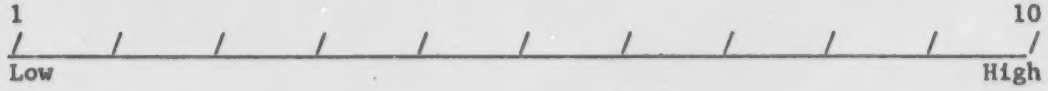



12. The teacher will be able to help the children become aware of living organisms in particular areas through field trips.

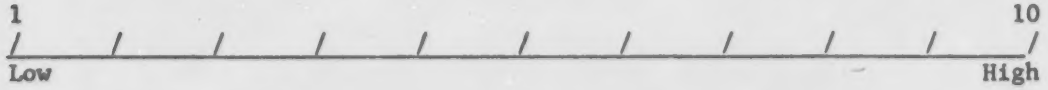



13. The teacher will be able to help children describe the range of an environmental factor as it occurs in an experiment or outdoors.

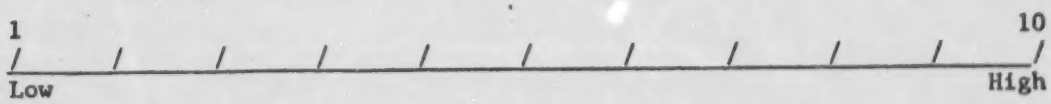
14. The teacher will be able to help children determine by experiment the best range of an environmental factor for an animal.



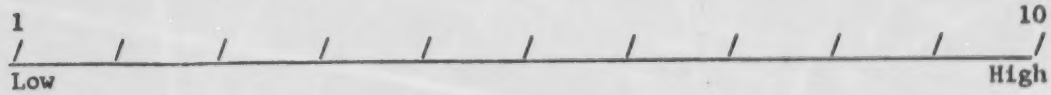

15. The teacher will be able to help children to investigate environmental phenomena by observational methods.



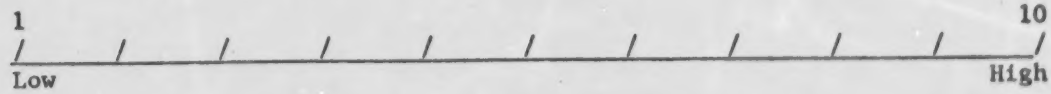
16. The teacher will be able to help children to relate and compare their observations with information presented in reference materials.



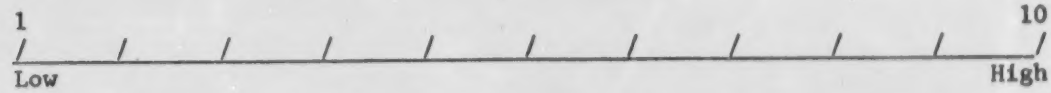

17. The teacher will be able to help children to record environmental data in several ways.



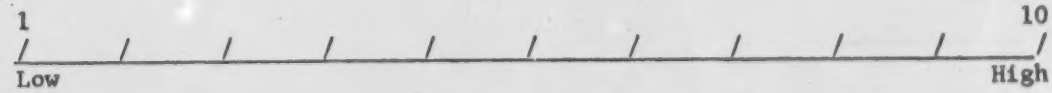

18. The teacher will be able to help children to use recorded data to infer time relationships.



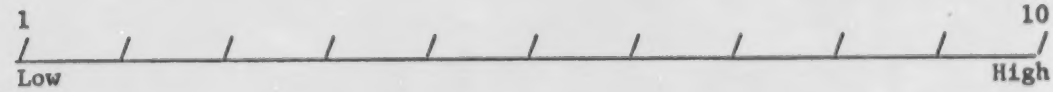

19. The teacher will be able to help children design an experiment to investigate the salt water environment to hatch shrimp eggs.



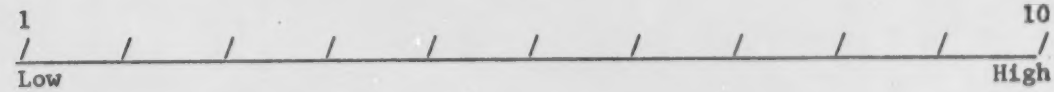

20. The teacher will be able to help children measure and record the growth of seedlings.



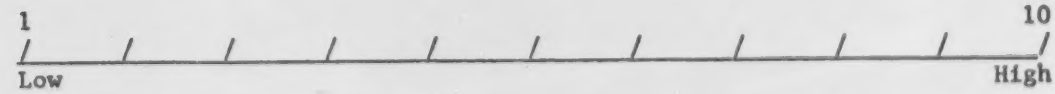

21. The teacher will be able to help children determine the average growth for each plant.



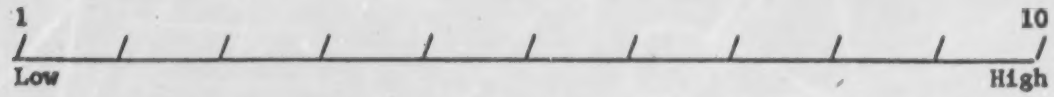

22. The teacher will be able to help children conduct a controlled experiment in relation to plant responses to light.



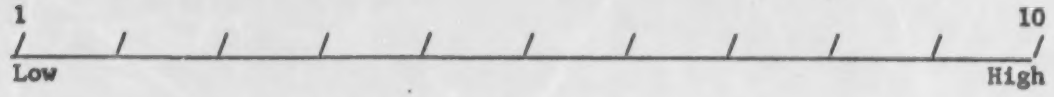

23. The teacher will be able to help children make inferences about the effect of changing the amount of light on plants outdoors.



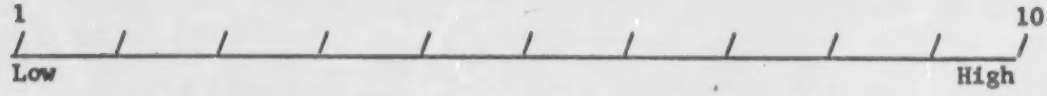
24. The teacher will be able to help children conduct a controlled experiment in relation to plant responses to temperature.



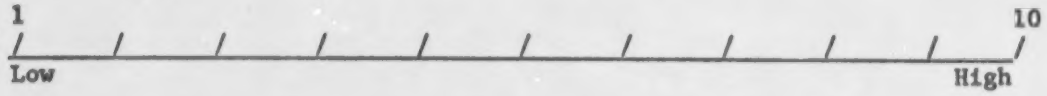

25. The teacher will be able to help children construct a new terrarium providing optimum ranges of environmental factors for the organisms studied.



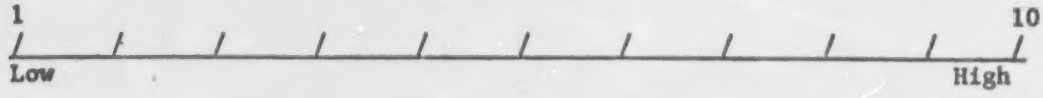

26. The teacher will be able to help children to conduct a controlled experiment to determine the feeding relationships of herbivore such as Daphnia.



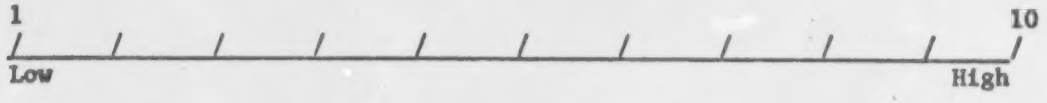

27. The teacher will be able to help children to conduct a controlled experiment to determine the feeding relationships of carnivore such as chameleons.



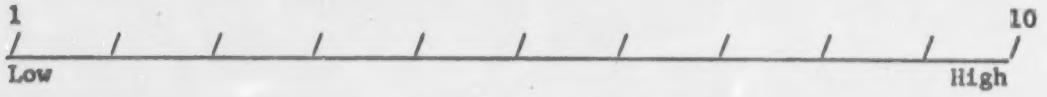

28. The teacher will be able to help children to identify interacting populations in aquaria and terraria.



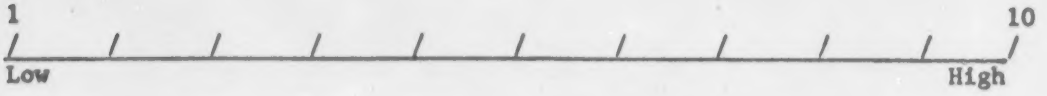

29. The teacher will be able to help children to make inferences about food chain and food web relationships in nature.



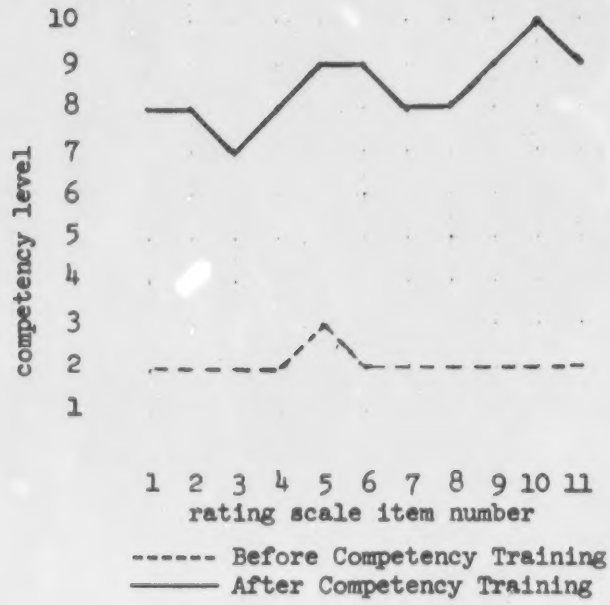

30. The teacher will be able to help children to illustrate predator and prey relationships.




31. The teacher will be able to help children to develop an operational definition of the term community.



TEACHER RESPONSES ON PART 1: TEACHER A




TEACHER RESPONSES ON PART II:
SPECIFIC TEACHER COMPETENCIES IN ENVIRONMENTAL EDUCATION

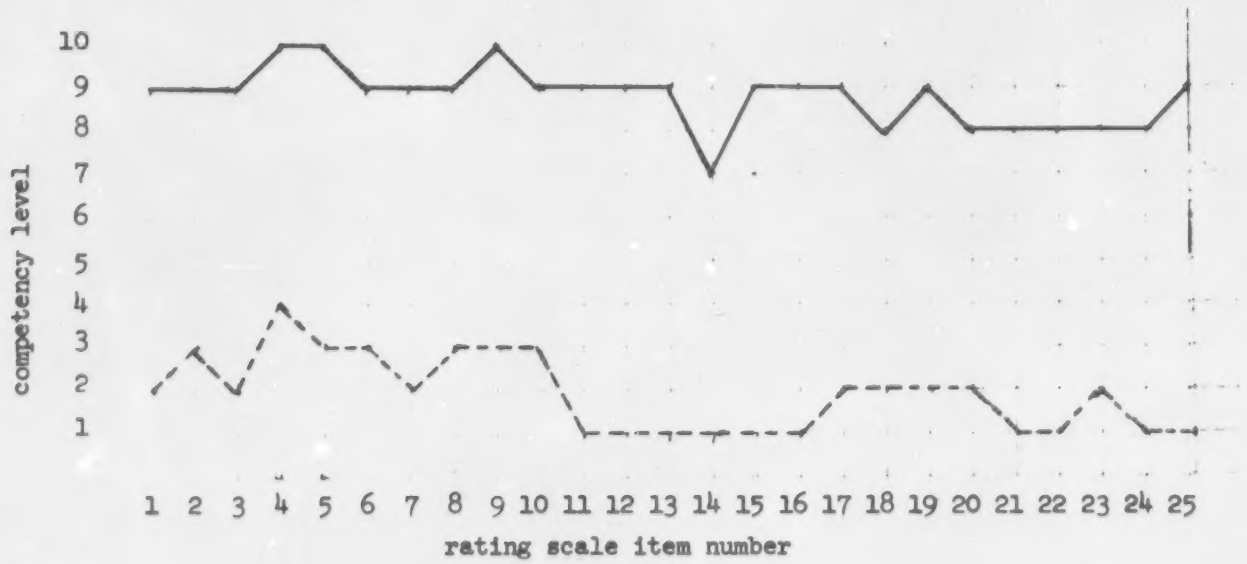
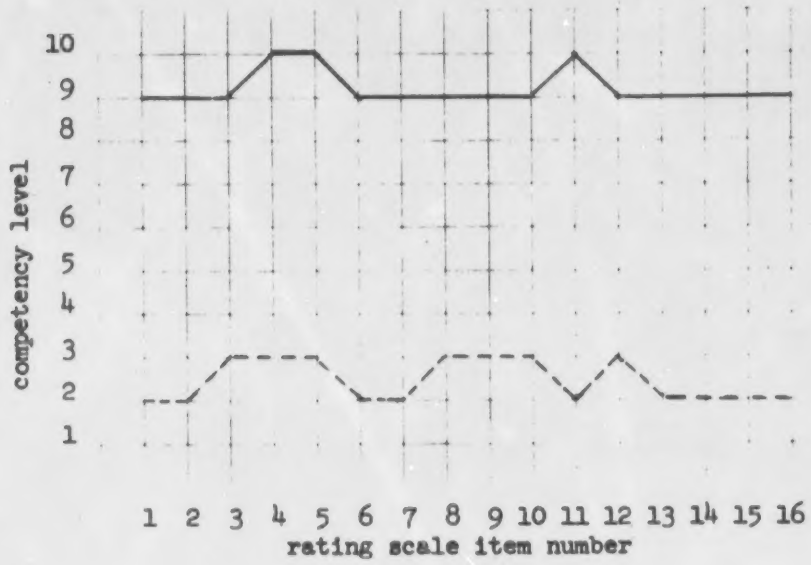



FIGURE 1A

TEACHER RESPONSES ON PART III: TEACHER A
SPECIFIC ENVIRONMENTAL EDUCATION TEACHING COMPETENCIES



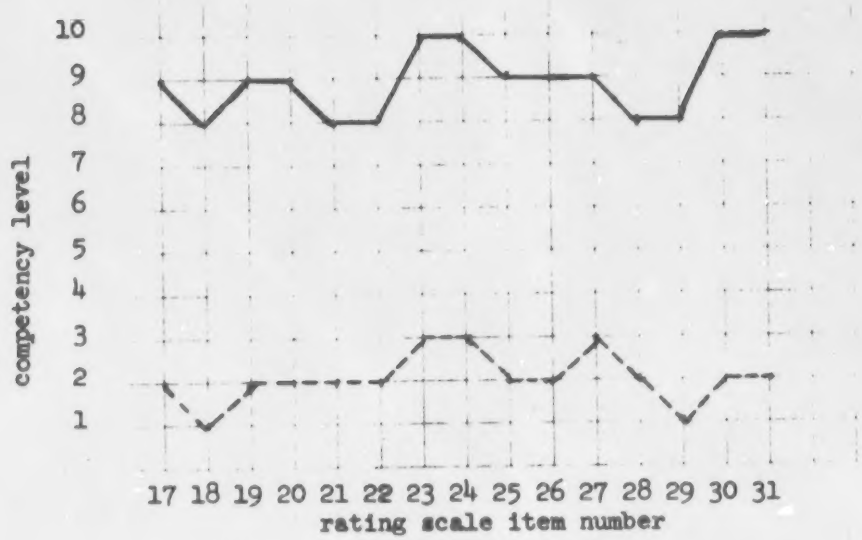
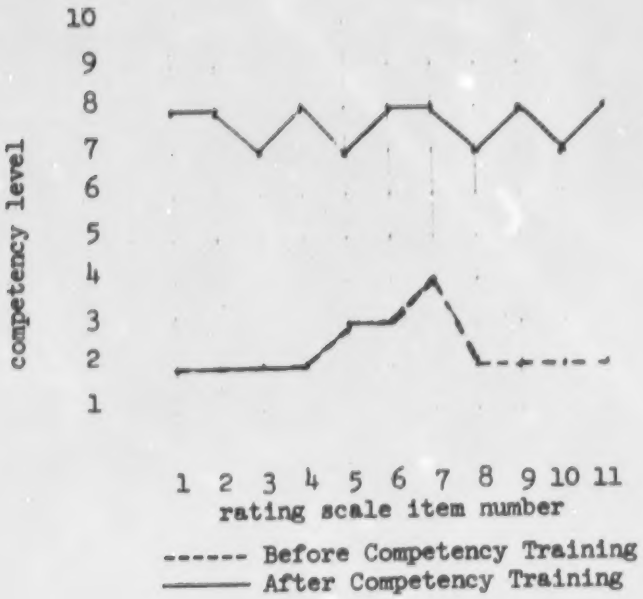




FIGURE 1A, Cont.

TEACHER RESPONSES ON PART 1: TEACHER B




TEACHER RESPONSES ON PART II:
SPECIFIC TEACHER COMPETENCIES IN ENVIRONMENTAL EDUCATION

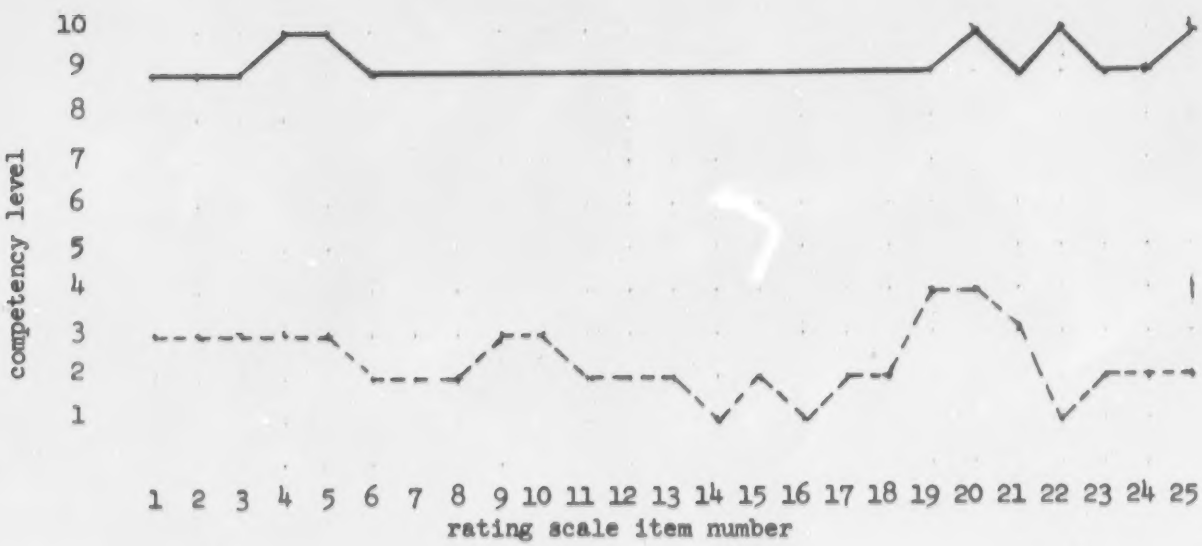
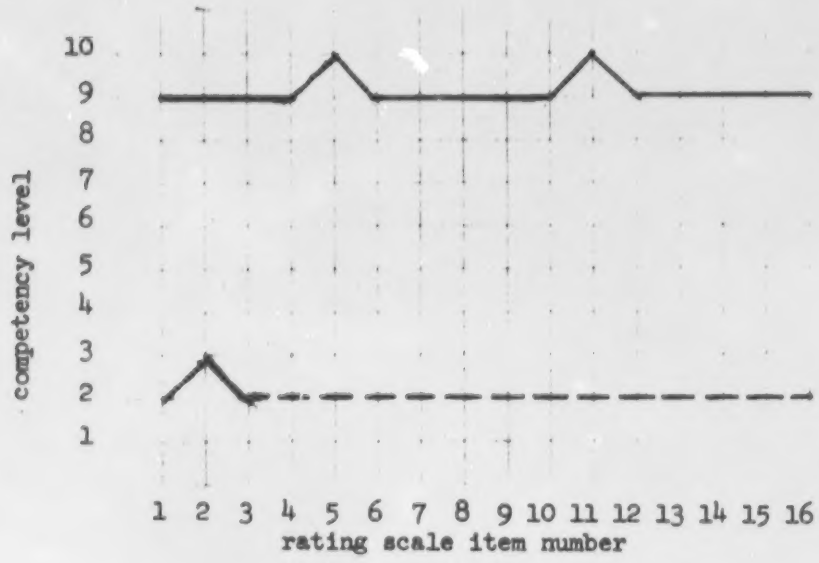



FIGURE 1B

TEACHER RESPONSES ON PART III: TEACHER B
SPECIFIC ENVIRONMENTAL EDUCATION TEACHING COMPETENCIES



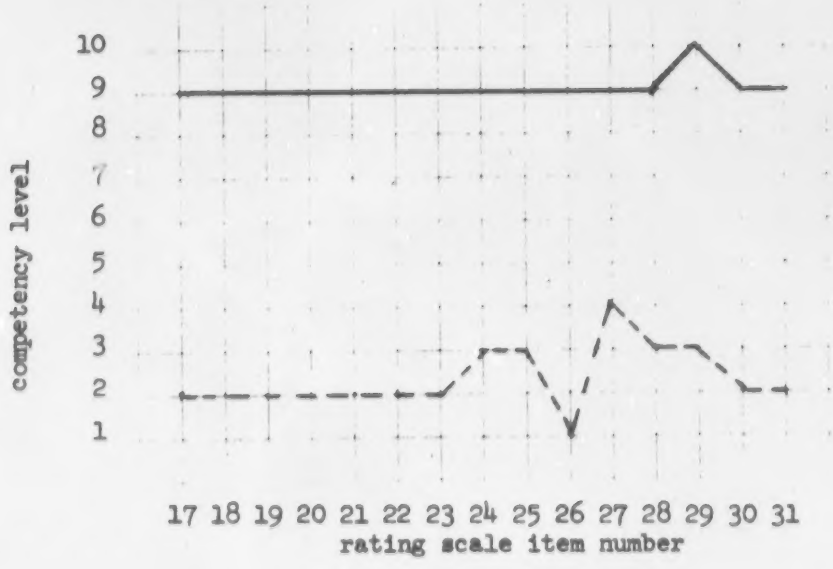
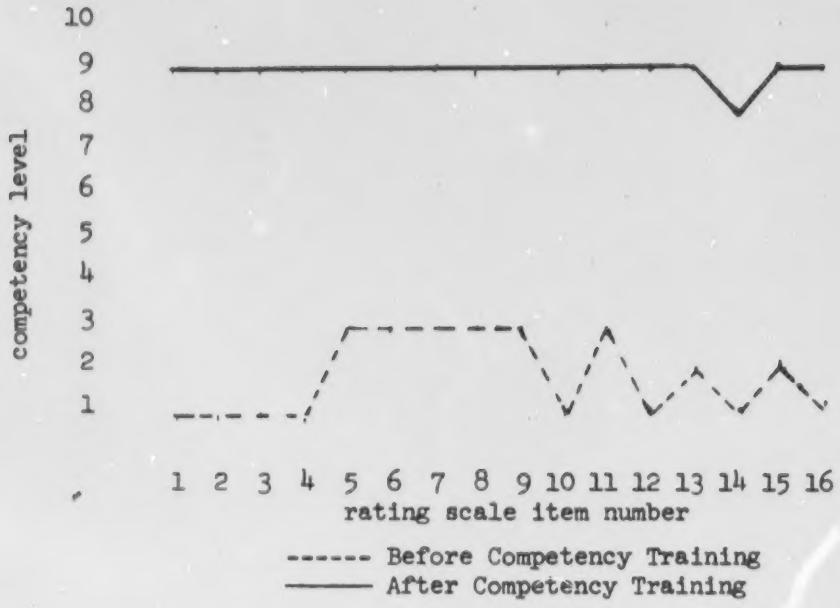




FIGURE 1B, Cont.

TEACHER RESPONSES ON PART 1: TEACHER D




TEACHER RESPONSES ON PART II:
SPECIFIC TEACHER COMPETENCIES IN ENVIRONMENTAL EDUCATION

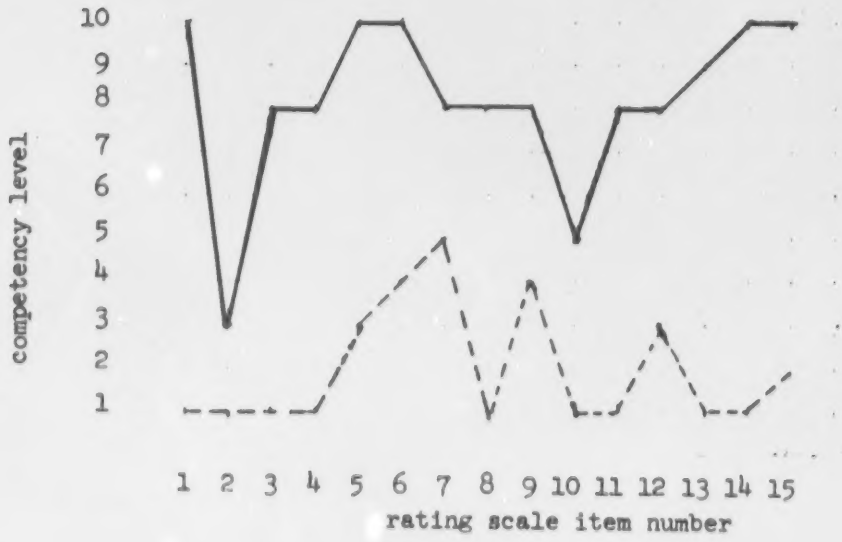
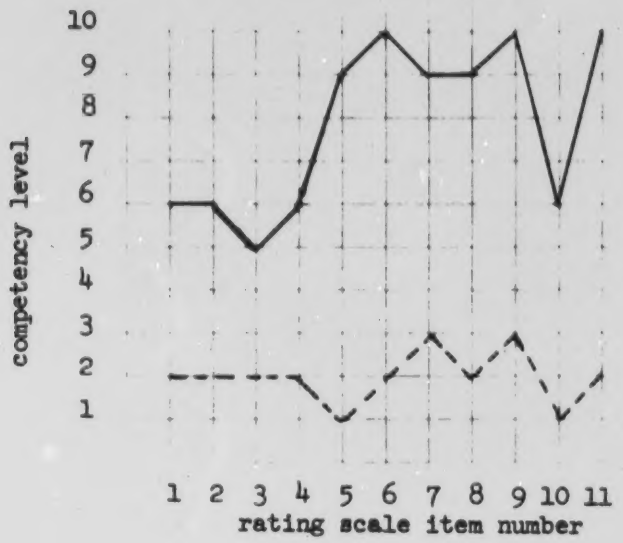



FIGURE 1D

TEACHER RESPONSES ON PART III: TEACHER D
SPECIFIC ENVIRONMENTAL EDUCATION TEACHING COMPETENCIES



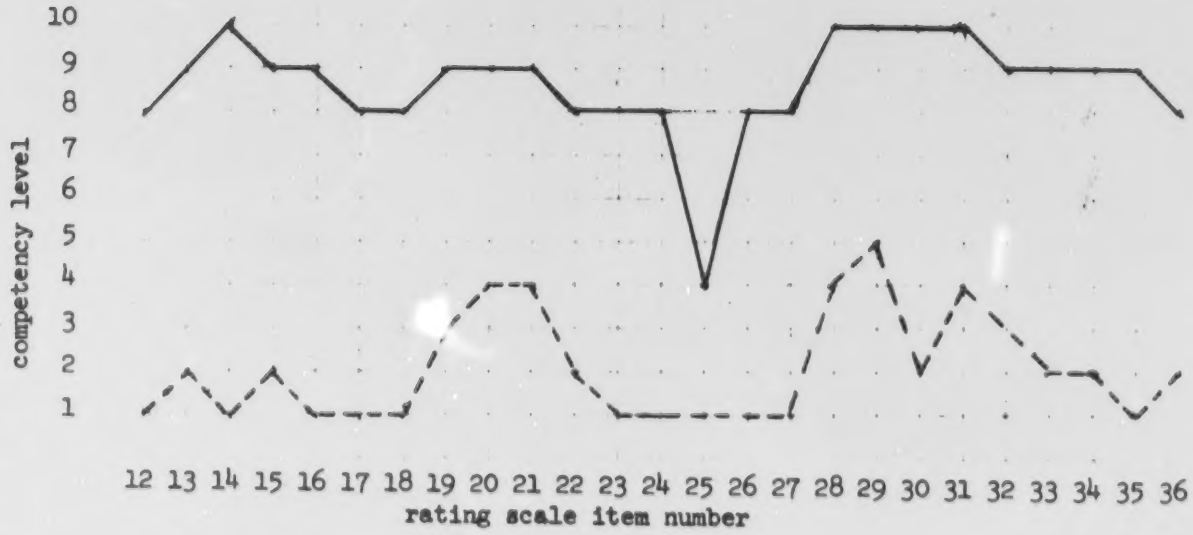




FIGURE 1D, Cont.

York College

Teacher C

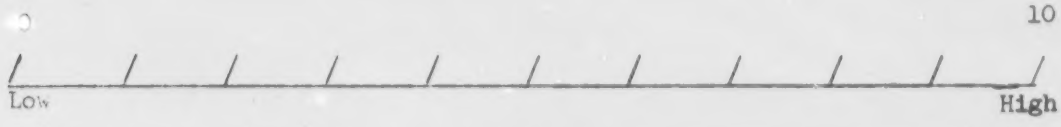
The self-reports of Teachers A, B, and D were on the 67 competencies listed on pages 18 to 23. In the case of York College, however, there was an emphasis on fewer and, in many instances, different competencies from those used by the other centers. This can be seen beginning with Item 5 in General Teaching Competencies, extending through General Teaching Competencies and through Specific Teacher Competencies. The York EEC group worked toward achieving the following competencies for Teacher C:

Evaluation of Teacher Objectives
for Ecosystem Unit

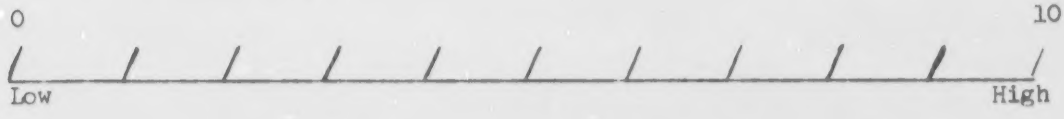
Checklist of Competencies for SCIS Ecosystems

General Teacher Competencies for SCIS Ecosystem

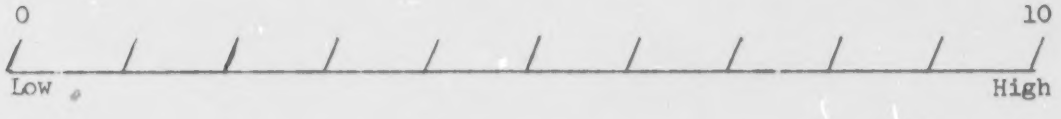
1. The teacher will be able to describe the environments of organisms.



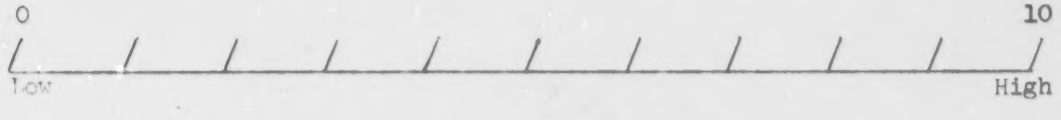

2. The teacher will be able to identify the environmental factors which affect living organisms.




3. The teacher will be able to describe food-mineral chains involving simple plants and animals.




4. The teacher will be able to design and conduct simple biological experiments involving independent and dependent variables, and controls.

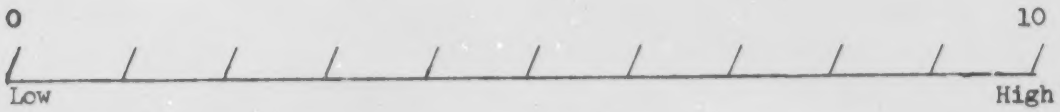


General Teaching Competencies for SCIS Ecosystem

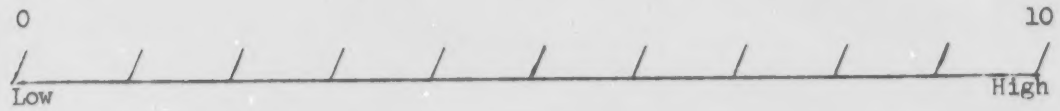
Items 5-12

The teacher is able to provide for opportunities for growth in the functional understanding of:

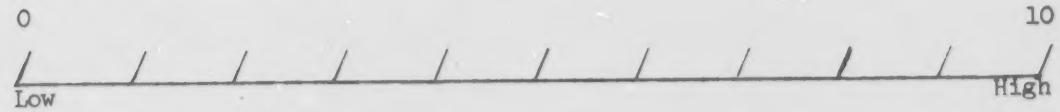
5. The nature of the abiotic and biotic environments.



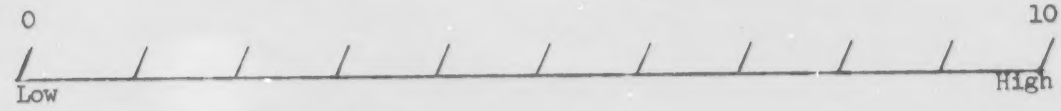

6. The nature of the ecosystem.



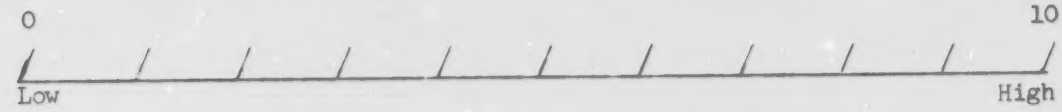

7. The nature of the food-mineral cycle.



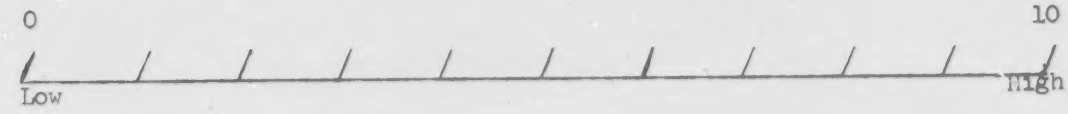

8. The nature of the water cycle.



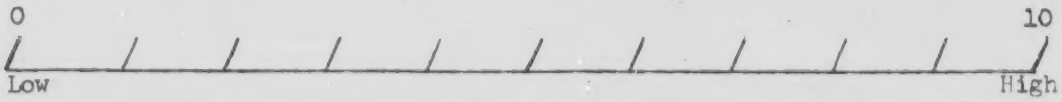

9. The nature of evaporation and condensation.



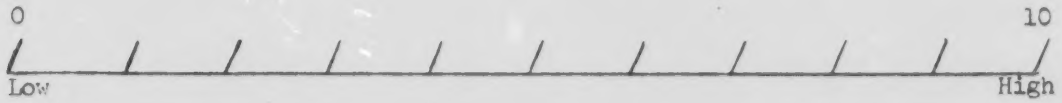

10. The nature of the oxygen-carbon dioxide cycle.



11. The nature of the causes of pollution.




12. The nature of the methods of eradication and control of pollution.




Specific Teacher Competencies for SCIS Ecosystems

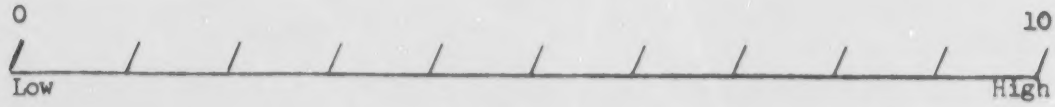
1. The teacher will be able to construct and maintain an aquarium-terrarium system.

2. The teacher will be able to develop operational definitions of the terms organism, pollution, community, ecosystem, and environment.

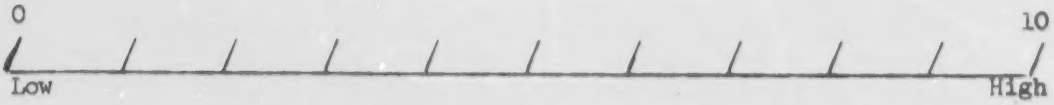
3. The teacher will be able to detect population changes within specific environments.

4. The teacher will be able to identify specific environmental factors which affect population growth and change.

5. The teacher will be able to design and conduct experiments to demonstrate evaporation and condensation.

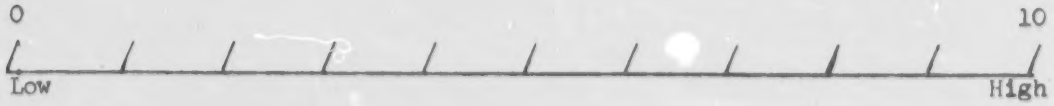



6. The teacher will be able to design and conduct experiments that demonstrate the oxygen-carbon dioxide cycle.

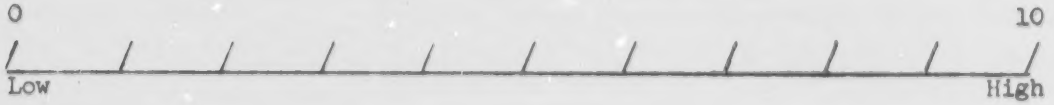



Specific Teaching Competencies for SCIS Ecosystems

1. The teacher will be able to guide children in setting up a terrarium-aquarium system.

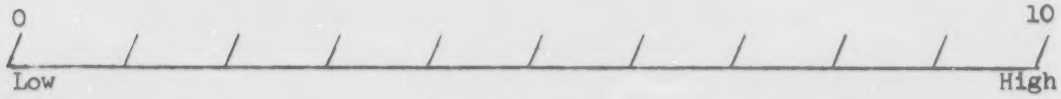



2. The teacher will be able to guide children to develop operational definitions of such terms as organism, population, community, ecosystem, and environment.

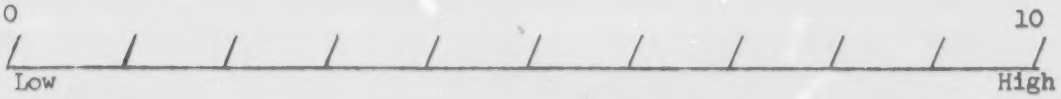



3. The teacher will be able to guide children in detecting population changes within a terrarium-aquarium system.

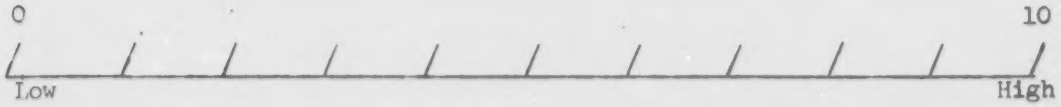
4. The teacher will be able to guide children to identify specific environmental factors affecting population changes in the terrarium-aquarium system.



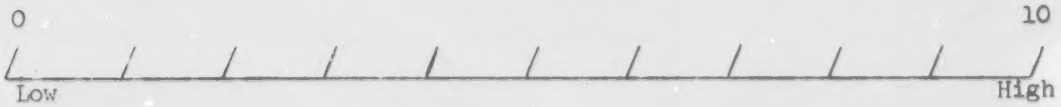

5. The teacher will be able to help children to describe living and non-living objects in terms of their physical, chemical, and biological composition, characteristics, and structure.



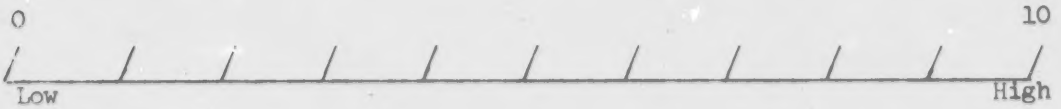

6. The teacher will be able to help children observe interactions of living and non-living matter.



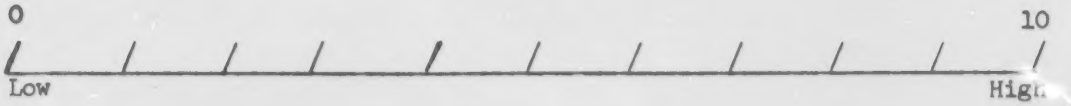

7. The teacher will be able to help children to describe the transformation of energy in living and non-living systems, such as the oxygen-carbon dioxide cycle.



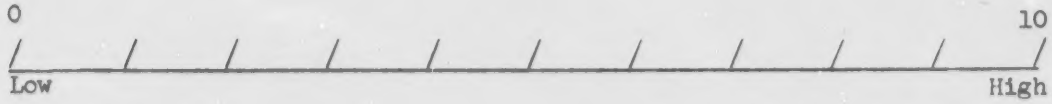

8. The teacher will be able to help children to plan controlled experiments.



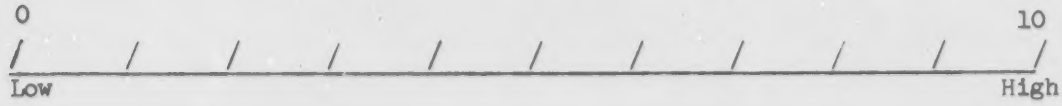
9. The teacher will be able to help children to design experiments to illustrate the oxygen-carbon dioxide cycle.



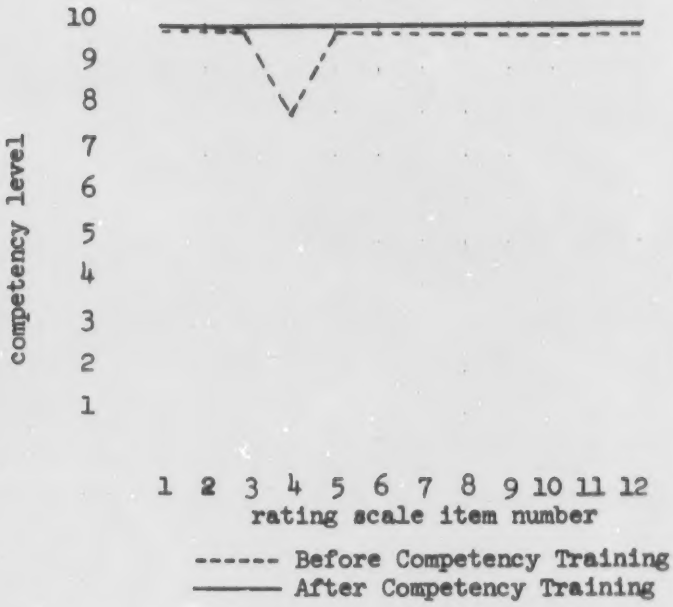

10. The teacher will be able to help children to design experiments to demonstrate evaporation and condensation.




11. The teacher will be able to help children to design experiments to illustrate the effects of pollution on plant and animal life.



TEACHER RESPONSES ON PART 1: TEACHER C




TEACHER RESPONSES ON PART II:
SPECIFIC TEACHER COMPETENCIES IN ENVIRONMENTAL EDUCATION

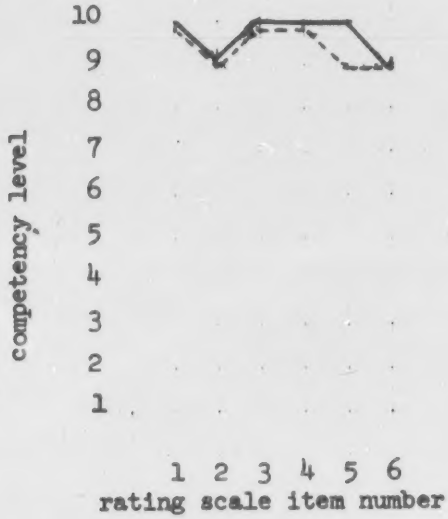



FIGURE 1C

TEACHER RESPONSES ON PART III: TEACHER C
SPECIFIC ENVIRONMENTAL EDUCATION TEACHING COMPETENCIES

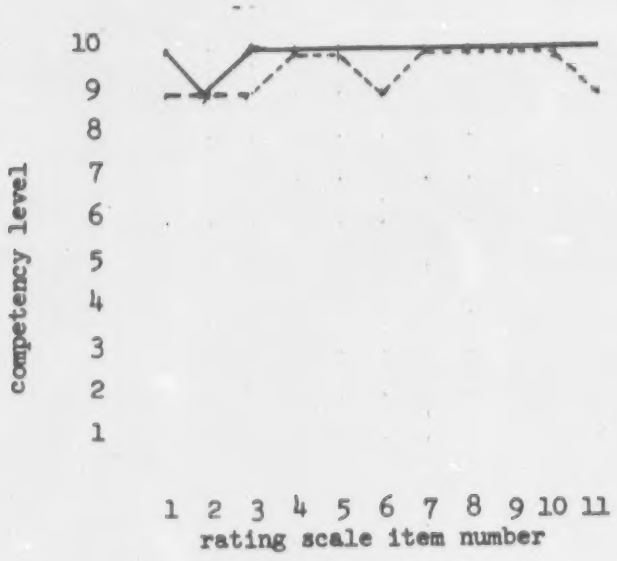



FIGURE 1C, Cont.

APPENDIX C

ENVIRONMENTAL EDUCATION COMPETENCY

TRAINING MODULES USED FOR

TEACHERS A, B, C, D

1. Richmond College 4th Grade Environments, Teachers A, B

Module I — Competency objectives. Philosophy of SCIS unit in Environments outlined, and the list of specific and general competencies to be developed. Elementary Teacher questionnaire administered.

Module II — First training session for the teachers. Teachers set up terraria composed of beetles, isopods, snails, bean seeds, clover, grass, and soil. The teachers observe the environment, identified the living and non-living components of the environment. Development of operational definitions of the terms organisms, population, and habitat. At the end of the session, the teachers are asked to make observations and to record data concerning their terraria during time interval between sessions.

Module III — The teachers report on the data that they had collected. Changes in population are discussed. The teachers are asked to invent models which describe changes within the environment and to identify specific environmental factors which affect population changes. The teachers develop an operational definition of the term environment based upon their data and the discussion. The teachers are then asked to gather data relating environmental factors outside the class and to examine a site suitable for classroom investigation. They are also asked to continue observing and recording data about their terraria.

Module IV — The teachers report on the continuing changes observed in their terraria. Several problems emerge from the ensuing discussion. The teachers then set up several experiments: The effect of light, water and temperature upon isopods, beetles and snails. Data is gathered on animal response to these conditions, and the teachers continue these experiments over the next few weeks.

Module V — The teachers report on the responses of the animals to the varying environmental factors. Attention is then focused upon plant response to a variation of environmental factors. The teachers then set up experiments dealing with plant response to light, temperature, water and chemicals. The teachers continue these experiments over the next few weeks.

Module VI — The teachers report on the responses of the plants to the varying environmental factors. Discussion centers upon all the data previously recorded, and the optimum conditions for each plant or animal. The teachers are then asked to construct a new terrarium using their experimental data and providing optimum ranges of environmental factors.

Module VII — Assessment, review and administration of evaluation of teacher objectives for environment unit instrument.

2. York College 6th Grade Ecosystems, Teacher C

| | |
|---|---|
| Module I | Objectives of the Program; Philosophy of SCIS; the nature of Ecosystems of SCIS. |
| Module II | Safety, Interaction, Matter, Energy, Organism, Ecosystem. |
| Module III | Process-Oriented concepts, Property, Reference Frame, System, Model. |
| Module IV | Overview of Organisms, Life Cycles, Populations, Environments, Communities, Ecosystems. |
| Module V | Aquaria, Terraria, Function of grass, Clover, Pea seeds, crickets in terrarium. |
| Module VI | Function of Anachris, Algae, Daphnia, Snails, Guppies in Aquaria, care of Animals and Plants. |
| Module VII | Log keeping by students. Student Discoveries - Water cycle, Evaporation, Condensation. |
| Module VIII | The mechanics of group work in SCIS lesson. Further student discoveries - Carbon Dioxide - Oxygen cycle. Function of organisms in that cycle. |
| Module IX | The value of trips in Environmental Education. The extension of the classroom to the outdoors in order to discover the cycles in nature. |
| Module X | The Food-Mineral cycle, Food Chain, Food Web. |
| Module XI | Pollution - Meaning; Effects of Pollutants on Ecosystems. |
| Module XII | Final review of basic principles students should learn. |

3. City College 5th Grade Environments, Teacher D

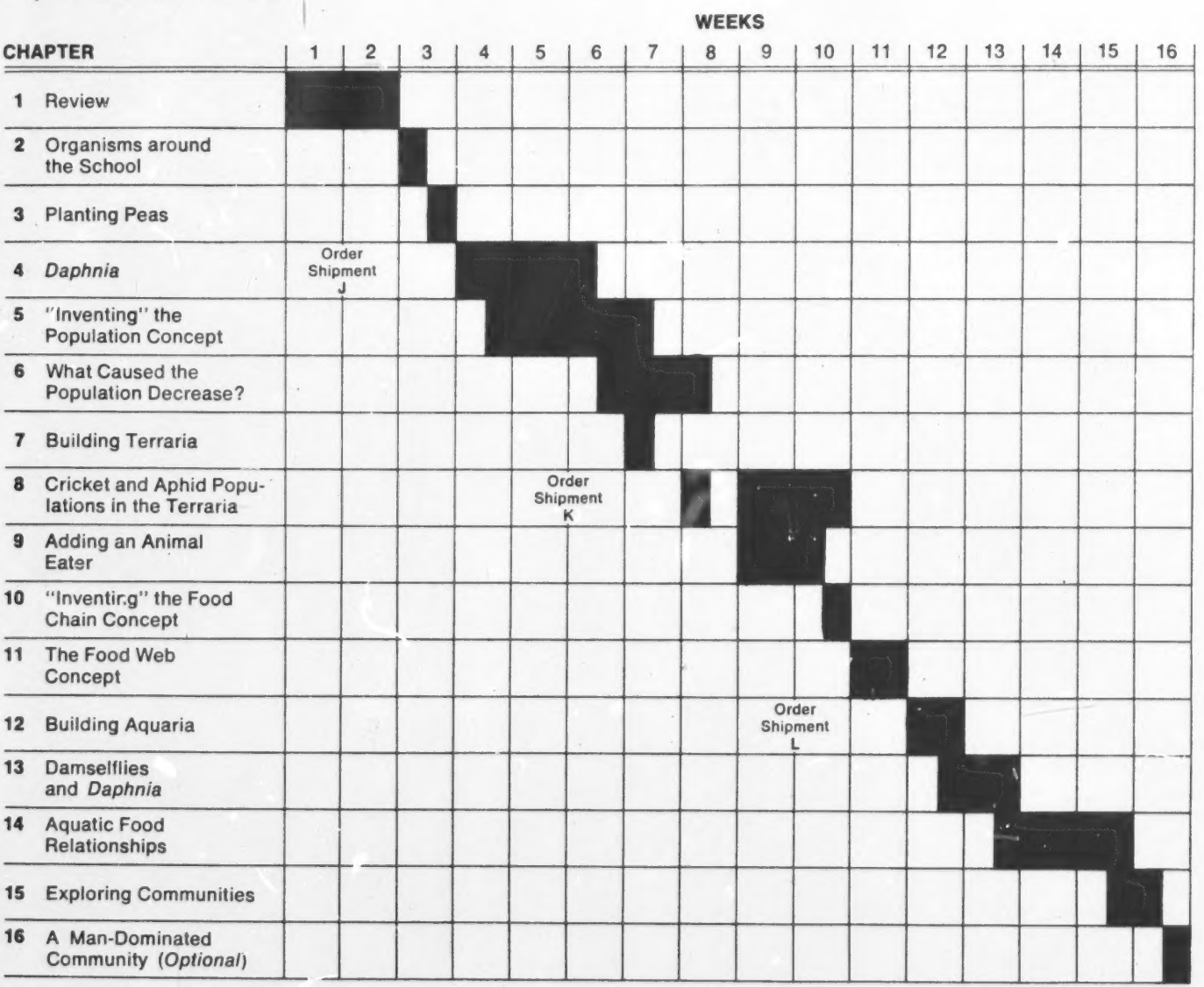
| | |
|---|---|
| Module I | Competency Objectives, philosophy of SCIS program, teaching techniques, schedule, overview, administration of Elementary Teacher Questionnaire. |
| Module II | Differentiate between plant and animal, living and non-living, habitat, construct terraria, observe, reports. |
| Module III | Populations, observing and recording changes, Environment and its factors - favorable, unfavorable, feedback, predictions and supporting evidence, class experiments. |
| Module IV | Field trips, changes in environments and organisms, observe and report neighborhood environs and animals. |
| Module V | Field trips, recording of environmental changes in plants and organisms, charts, graphs. Precipitation, temperature changes recorded. |
| Module VI | Observation of organisms in natural habitat, recording of conditions, temperature variations, moisture, life cycle concepts, counting, prediction. |
| Module VII | Range, optimum range of animals-plants, histograms, forming hypotheses, designing experiments, interpreting data. |
| Module VIII | "Inventing" range and optimum range, development of experiments to determine ranges for animals. Recording data, drawing conclusions. |
| Module IX | Knowledge of range applied to Isopods. Reactions to light, water, temperature, concept of variables, controlled experiments. |
| Module X | Experimentation to determine optimum range for snails, water, light, temperature, concept of variation, review of data and inference. |
| Module XI | Student invention of experiments to determine responses of beetles to water, light, temperature. Infer from data kinds of environment suitable for beetles. |
| Module XII | Experimentation with Brine Shrimp in salt water. Use of various densities. Discovery of other environmental factors. |
| Module XIII | Growth responses of plants, differing environments, experimentation of optimum range. Germination of clover and grass under varying conditions. Life cycles of plants. Response to light, temperature, water, chemicals. |

Module XIV — The total environment, similarities, differences. Responses of plants and animals. Construction of a terrarium based on knowledge gained from data recorded regarding light, water, temperature, soil, life cycles, chemicals, optimum ranges.

# APPENDIX D

## SCIENCE CURRICULUM SCHEDULE

## *Populations* Schedule


WEEKS
CHAPTER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
1 Review
2 Organisms around the School
3 Planting Peas
4 *Daphnia*
Order Shipment J
5 "Inventing" the Population Concept
6 What Caused the Population Decrease?
7 Building Terraria
8 Cricket and Aphid Populations in the Terraria
Order Shipment K
9 Adding an Animal Eater
10 "Inventing" the Food Chain Concept
11 The Food Web Concept
12 Building Aquaria
Order Shipment L
13 Damselflies and *Daphnia*
14 Aquatic Food Relationships
15 Exploring Communities
16 A Man-Dominated Community (*Optional*)



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# APPENDIX E

## DIAGRAM OF EQUIPMENT KIT FOR

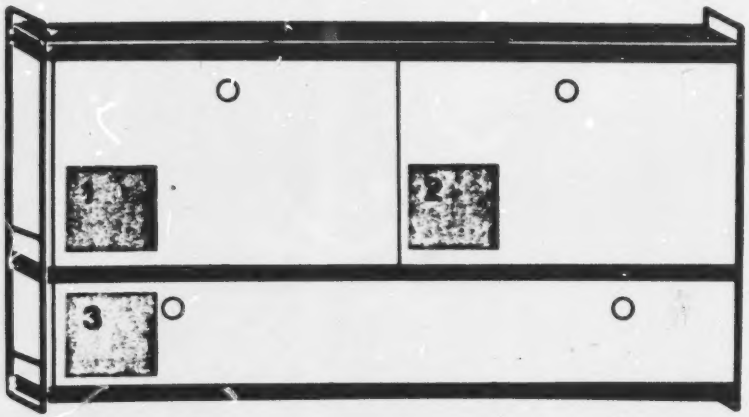
## SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS)

## POPULATIONS UNIT

# DESIGN AND USE OF THE KIT

The equipment kit for *Populations* has been designed to simplify and make convenient the use and storage of the required equipment and supplies. A diagram of the kit, listing the contents of each drawer, appears on the top shelf. We suggest that you become familiar with the arrangement of the materials within the drawers. Necessary materials for a class of thirty-two students are listed at the beginning of each chapter. Sometimes you are asked to supplement these with standard classroom supplies.

Some organisms studied in this unit are not included in the kit. Instead, they will be sent separately when your completed order forms are received. Therefore you should mail Form J at least three weeks before the date on which you wish to begin Chapter 4, Form K at least three weeks before you wish to begin Chapter 8, and Form L at least three weeks before you wish to begin Chapter 12.




| Drawer | Item Description & Quantity |
|---|---|
| 1 Terrarium Materials | 4 two-gallon plastic containers with lids<br>2 water sprinklers<br>20 vials with caps<br>1 baster<br>3 living-material order forms (J, K, and L) |
| 2 Terrarium Materials | 4 two-gallon plastic containers with lids<br>2 water sprinklers<br>20 vials with caps<br>16 magnifiers<br>7 plastic bags |
| 3 Assorted Materials | 16 fluted containers<br>16 planter cups<br>16 planter bases<br>20 plastic tumblers<br>16 square *Daphnia* counters<br>32 wooden sticks<br>16 medicine droppers<br>1 light source<br>25 twistems<br>1 dip net<br>3 packages pea seed<br>1 package grass seed<br>1 package mustard seed<br>2 packages clover seed<br>1 vial brine shrimp eggs<br>1 package noniodized salt<br>1 package pipe cleaners<br>1 roll labels<br>32 small *Populations* pictures<br>1 large *Populations* picture<br>32 *Organisms Record Sheets*<br>1 *Daphnia* chart<br>1 *Daphnia* graph paper<br>1 *Aphid* chart<br>1 *Aphid* graph paper<br>1 *Aquarium Populations* chart<br>1 sheet labels (*Daphnia*, snails, damselfly larvae) |

**Sand and Soil Box:**

1 bag sand (5 lb)
2 bags soil (12 lb/bag)

**Shipment J:**

2 pints algae culture
200 *Daphnia*
100 aphids

**Shipment K:**

80 crickets
7 chameleons

**Shipment L:**

1 pint algae culture
16 damselfly larvae
24 pond snails
200 *Daphnia*
17 sprigs *Anacharis*
1 jar *Wolffia*

# APPENDIX F

## ECOLOGY BIBLIOGRAPHY

# Children's Ecology Books

A note on the Preparation of this Bibliography: Mrs. Martha Lussenhop, the compiler of this bibliography, brings to her effort important qualifications: she holds a Master's degree in zoology, is a qualified elementary school teacher, and has a good background in children's literature. For this list, Mrs. Lussenhop selected fiction and non-fiction books which add to an understanding of ecology, broadly considered here as the study of the interrelationships of organisms to each other and their environment. Most of the titles are in the CCBC collection. For a critical overview of the literature in this field, one may refer to Mrs. Lussenhop's essay "Ecology Books for Children" in the CCBC Circular for May, 1971. The special lettering for this publication was done by Mr. Ray Lussenhop.

## General Ecology

Ayer, Margaret. Animals of Southeast Asia. Illus. St. Martin's, 1970. $4.95. Gr. 7 - Adult.

This unusual selection describes the sea and land animals of Southeast Asia, their physical environment, and the ways in which the literature, art, religions, and customs of the peoples reflect their concern for the animal life. Because the war in Vietnam has altered the habitats of many animals, some may live on only in such cultural forms.

Bendick, Jeanne. A Place to Live. Illus. Parents' Magazine, 1970. $3.95. Gr. 1-3.

A simple clear text with comic-type illustrations which takes off from the young reader's familiarity with his neighborhood to introduce the concept of community with respect to other living things. The author explains the terms "producers and consumers," "environment," and "climate" from the standpoint of the child's own experiences. She asks questions which urge the reader to relate his life needs to those of animals and plants. By concluding the book with some big "ifs," the author suggests certain grim situations are very possible but not inevitable.

Brandhorst, Carl T. and Robert Sylwester. The Tale of Whitefoot. Illus. by Grambs Miller. Simon & Schuster, 1968. $3.50. Gr. 3-7.

A story of the decomposition of a white-footed mouse who dies some time after giving birth to five little ones. Soil organisms and micro-organisms participate in the breaking down of Whitefoot's body, deriving energy and protein-building materials for their own maintenance. Whitefoot also lives on in the structure of grass and other plants, in the grasshopper who nibbled the grass, and in the mouse who consumed the grasshopper. So, in a non-gruesome way, two biologists depict the cycle of life, death and rebirth. The exquisite illustrations, fine line drawings in black and white, convey the inseparability of the mouse from her organic and inorganic surroundings.

Buff, Mary and Conrad. Elf Owl. Illus. by Conrad Buff. Viking, 1958. $3.50. Gr. 2-5.

The life of desert plants and animals is told in cadenced prose and beautifully illustrated in shades of brown. Members of the desert community share a need for water and, depending on the season, they find it or do not find it in the water hole below the home of Elf Owl in the giant cactus. Readers can learn, without being told explicitly, why cacti and porcupine have spines and quills, and how deer, wolf, fox, rabbits, rats, roadrunners, and owls manage to survive in the dry desert.

Busch, Phyllis S. Once There Was a Tree: The Story of the Tree, a Changing Home for Plants and Animals. Photographs by Arline Strong. World, 1968. $4.50. Gr. K-3.

A photographic essay describing "how a living tree becomes a log, and how its accompanying varieties of plants and animals interact with each other and with the environment." Young readers explore the life in, on, under, and around a tree, including birds, insects, lichen, and fungi. Some of these harm and some help the tree. But even as it decays, falls, and becomes a log, the tree provides shelter for many animals, and when it becomes part of the soil, it provides food for the growth of a new tree. The author and photographer also collaborated on a fine book with a very similar format and purpose -- Puddles and Ponds: Living Things in Watery Places.

Dobrin, Arnold. Marshes and Marsh Life. Illus. Coward, 1969. $3.86. Gr. 3-5.

In this beautifully illustrated book, discussion of blackbirds, cattails, turtles, muskrats, snakes, frogs, and marsh hawks is fully integrated, so conveying to the reader the complex web formed by the interrelationships between animals, plants, and their environment. The author points out one function of wetlands which is too often overlooked, --that of preventing adjacent areas from being flooded or destroyed by wind.

Eckert, Allan W. Wild Season. Illus. by Karl E. Karalus. Little, 1967. $4.95. Gr. 7 - Adult.

A quiet but intense in-depth depiction of the drama taking place during the month of May among wildlife in and around a lake near the Wisconsin-Illinois border. The author states the theme as he describes Oak Lake in his prologue: "No creature here is not in large measure dependent upon other creatures of its own or other species for survival; and no creature here does not give of itself --even if ultimately it be by death -- to the continuance of the whole natural scheme of things." Each chapter focuses on the life of one predator on one day in May, and by the end of the next chapter he becomes the prey of another creature. An excellent book to read aloud and to use as a source of material for a mural showing the links making up a food chain or web.

Fisher, Aileen. Summer of Little Rain. Illus. by Gloria Stevens. Nelson, 1951. $2.95. Gr. 5-9.

A dramatic but realistic account of how a beaver family and a pine squirrel family survive one summer when faced with unfamiliar circumstances brought on by an autumn forest fire upstream from the pond. While keeping the reader in suspense, the author conveys the complex interdependency between beavers and deciduous forests, pine squirrels and coniferous forests. The reader learns why lodgepole pines manage to sprout and thrive when other pines do not, and also information about the daily and seasonal behavior, food habits, and enemies of the beaver and pine squirrel.

George, Jean. The Hole in the Tree. Illus. Dutton, 1957. $3.75. Gr. K-3.

Not less than eighteen species of beetles, bees, ants, birds, and mammals made their home in the apple tree, one replacing the other. Each occupant made the hole a little larger to fit herself and her offspring. Not a one became a permanent occupant, and even the boy Paul had to abandon his claim.

George, Jean Craighead. The Thirteen Moons Series. Crowell, published from 1967 - 1970. $3.75. Gr. 3-6.

A series of thirteen books, each describing a different animal species, an important event in its life during a particular month of the year in a certain habitat. Many other living things which the animal encounters, or eats, are also described, indicating the interrelationships between the organism and its environment. The thirteen "moon books" are about alligators, bears, chickarees, deer, fox pups, gray wolves, moles, monarch butterflies, mountain lions, owls, salamanders, wild pigs, and winter birds. Each book is about sixty pages and is illustrated by a different artist. The text consists of short, clear sentences, and while containing a great deal of information, reflects the author's wish to cultivate an appreciation for the beauty and complexity of the natural world.

Hirsch, S. Carl. The Living Community: A Venture into Ecology. Illus. by William Steinel. Viking, 1966. $3.75. Gr. 7 - up.

This is one of the few books bringing out the contemplative aspects of ecology. The author considers the basic elements of the science, including evolution and adaptation, and gives illustrative examples. His allusions to appropriate quotations by such writers as Henry Thoreau, Lewis Carroll, Daniel Defoe, Robert Burns, and William Shakespeare make the book especially readable and also suggest that ecological ideas are not new. Man pervades the lucid text but is viewed realistically as one who has made mistakes, recognized some of them and now, as the most intelligent of creatures, has the responsibility to make the earth a fit place to live.

Hoover, Helen. Animals at My Doorstep. Illus. by Symeon Shimin. Parents' Magazine, 1966. $3.21. Gr. K-3.

The wild creatures surrounding the author's home in the forest become her friends, and by observing them quietly, she learns that "everything that grows and lives is important to all other living things." The reader learns how animals, birds, insects, and plants are interdependent, how their populations are ecologically balanced, and how many are camouflaged as an adaptation to their environments. The illustrations are realistic and in vivid colors.

Howell, Ruth Rea. A Crack in the Pavement. Photographs by Arline Strong. Atheneum, 1970. $3.50. PreS - Gr. 2.

A photographic essay calling young children's attention to the living things in their everyday environment of the city: grass dandelions, and ants in the cracks of a sidewalk; pigeons and sparrows nesting on window sills and under eaves of apartment buildings; robins, squirrels, inchworms, aphids, ladybugs, and spiders in the park. The author and photographer collaborated on an earlier book of similar format, Everything Changes, which directs young children's attention to the seasonal changes of plants and animals in their own schoolyard and city park.

Hutchins, Ross E. Little Chief of the Mountains. Illus. by Jerome P. Connolly. Rand McNally, 1970. $3.95. Gr. 3-5.

Only those who hike up mountains to the rock slides near timberline are likely to hear the high-pitched cry of the coney, and only those who strain their eyes can spot these elusive, rabbit-like critters. Hutchins did visit their domains on the slopes of Grand Teton and wrote this story of a family there. He contrasts the coney's wintering habits with those of the neighboring marmot and bear, in this way illuminating the species' autumn ritual of harvesting hay for the winter food supply. The two-color drawings capture the coney's charming expression and posture.

Hylander, Clarence. Wildlife Communities: From the Tundra to the Tropics in North America. Houghton, 1965. $5.00. Gr. 7 - Adult.

A very comprehensive treatment of ecology for high school readers, presenting "the role of environment in determining the appearance, living habits, and distribution of the plants and animals that make up our wildlife heritage." The first part considers the concepts of ecology, adaptation, and community, and the second part describes six biomes in North America. Numerous diagrams, photographs, maps, and charts amplify the text.

Kane, Henry B. Four Seasons in the Woods. Knopf, 1968. $3.50. Gr. K - 3.

A very gentle book for young readers which conveys the author's deep awareness of his natural environment. He describes hibernation, migration, and protective coloration as they concur with the four seasons. The concise text is accompanied by photographs and line drawings of plants and animals. Other very appealing books by this author are the nature studies Tale of a Meadow, Tale of a Pond, and Tale of a Wood for older children and adults.

May, Julian. The Big Island. Illus. by John Schoenherr. Follett, 1968. $3.95. Gr. K-3.

A simplified version of the predator-prey equilibrium which was eventually established between wolves and moose on Isle Royale. Until the wolves came to the island and fed on the old and sick moose, the moose population grew too large for the limited food supply on the island. As a result, many starved. The illustrations, in subdued browns, greens, and greys, have strong texture and the animals portrayed appear very much alive.

Miles, Miska. Apricot ABC. Illus. by Peter Parnall. Atlantic-Little, 1969. $3.95. Gr. K-3.

An alphabet book in verse which introduces very small children to the community of plants and animals living close to and under the earth's surface. Crickets, dragonflies, earwigs, katydids, and titmice crawl or flutter into and under dillweed, jasmine, and oleander. On one summer day only the fallen apricot remains still. A hen who seems all feet puts the tiny meadow creatures in a tizzy and they all seek cover. The hen finds the apricot but consumes not all of it --leaving the pit to become a new apricot tree. The illustrations, in color, are stunning and offer many unusual details for discussion.

Milne, Lorus and Margery. The Phoenix Forest. Illus. by Elinor Van Ingen. Atheneum, 1968. $3.95. Gr. 4 - 6.

A book both moving and informative, focusing on a forest community and its slow regeneration after a great fire (analogizing this with the rebirth of the legendary Phoenix bird). The authors explain how nothing in such a community is wasted --everything, living or dead, providing energy for some other animal, plant, or microorganism, the nutrients circulating in endless cycles. The description of the fire is terrifying (an ancient oak tree is struck by lightning and everything in or on it is electrocuted), but from this climax, readers learn how the immediate devastating effects of the fire are within a year transformed: pioneer plants which did not have a chance to grow when dominated by larger hardwood trees proliferate on the burned area and supply food and cover for returning wildlife.

Morrow, Betty. See Up the Mountain. Illus. by Winifred Lubell. Harper, 1958. $3.95. Gr. 3 - 6.

The author leads her readers on a hike up a high mountain, noting the startling changes in habitat from one zone to the next. Each zone is characterized by a particular community of plants and animals which have been able to adapt to climatic conditions at that altitude. The trip upwards from hot to cold temperatures parallels one we would all experience if traveling from the equator to the arctic.

Nickelsburg, Joan. Ecology: Habitats, Niches, and Food Chains. Illus. by Joan Drescher. Lippincott, 1969. $4.50. Gr. 7 - Adult.

A clearly written introduction to the principles of ecology which aims "to describe a number of habitats and the organisms living in them, some of their adaptations for survival, and ... the effect these organisms have upon their environment and upon one another." Along with habitats, niches, and food chains, the concepts of biomes, ecological pyramids, and plant succession are explained and illustrated with examples from regions in the United States. Photographs, two diagrams, a bibliography, and an index accompany the straightforward text.

Pringle, Laurence. From Field to Forest: How Plants and Animals Change the Land. Illus. World, 1970. $4.50. Gr. K - 3.

A photographic essay "planned to encourage the very young child to experience his environment aesthetically as well as intellectually" (from foreword). Plant succession is portrayed as a very slow parade of plants, beginning with bare soil and ending with an oak-hickory forest. The lucid text also describes different types of seeds, the ways they are transported, and the various creatures which are attracted to the changing habitat.

Raskin, Edith. The Pyramid of Living Things. Illus. by Joseph Cellini. McGraw, 1967. $4.50. Gr. 7 - Adult.

Forming the organization of this selection are eight climatic zones of the world, ranging from the Arctic and Antarctic Tundra to the Tropical Rainforest. Each biome is introduced with a diagrammatic pyramid of living things representing the food web, productivity, and biomass characterizing the ecological community. The text describes the climate and vegetation of each biome and also portrays the activity patterns of wildlife. Pointing to human beings as the ultimate predators, the author asserts that we must become conservers if we are to survive at all.

Rublowsky, John. Nature in the City. Basic Books, 1967. $4.95. Gr. 7 - Adult.

A very welcome book which draws the reader's attention to the myriad of living creatures which have adapted to the concrete and asphalt environment of the city. The city, the author points out, is not an unnatural environment but only a new one to which organisms must adapt if they are to survive; and the natural history and ecological relationships among the surviving are no less intriguing than those in the wilderness. Although the text is in small print, it is clear and lively. Eight photographs, a bibliography and an index increase the usefulness of this book.

Russell, Helen Rose. City Critters. Illus. by Marcia Erickson. Hawthorn, 1969. $3.95. Gr. 4-7.

A very informative book which traces the changes that have occurred between the time America was wilderness and the present time of extensive urban development. The author describes the natural history of sparrows, pigeons, rats, and insects which have so successfully adapted to city life, and also conveys the complex interrelationships which occur between the city critters.

Selsam, Millicent. Birth of a Forest. Illus. by Barbara Wolff. Harper, 1964. $2.95. Gr. 3 - 7.

A clear and accurate presentation of plant succession, stressing the slowness at which natural forces operate in transforming a pond to the climax community of a region. Detailed ink drawings amplify the text which describes how animals and the seeds of plants reach the pond, and how the dead remains of organisms help prepare the soil for the growth of a different group of plants. The pond becomes a marsh, the marsh becomes a swamp forest, and the trees whose seedlings can grow in shade eventually become the dominant plants in the forest.

Selsam, Millicent. See Through the Forest. Illus. by Winifred Lubell. Harper, 1956. $3.95. Gr. 3 - 6.

Young readers explore the forest (made analogous to a tall building) from its moist, dark, and cool basement to its dry, hot and airy top, discovering the tenants which are particularly adapted to the climate of their own floor. We learn the use of woodpeckers in controlling populations of woodboring beetles, of insect-eating birds in controlling the numbers of leaf-eating caterpillars, and of lady-bird beetles in preventing destructive plant lice from multiplying. Most importantly, we learn that every tenant of the forest, no matter his level, is affected by others in the total community.

Selsam, Millicent. See Through the Lake. Illus. by Winifred Lubell. Harper, 1958. $3.79. Gr. 3 - 6.

A lucid presentation of the interdependent life forms in the freshwater lake community. The readers accompany the author in collecting and observing the plants and animals found at various depths. Particular point is made of the lake's own cycle --bigger animals eating smaller ones which eat still smaller animals which depend on tiny plants. All these forms eventually die and are decomposed by bacteria, providing the minerals allowing more algae to grow. We learn also how the lake itself is interdependent with the land surrounding it.

Stephen, David and James Lockie. Nature's Way: A Look at the Web of Life. Illus. with photographs. McGraw, 1969. $4.95. Gr. 5 - up.

One strong point of this reference book is its introduction which presents a comprehensive definition of ecology: "a method of discovering facts ... the study of animals and plants, their relationships to each other and to their environment ... a way of looking at all other sciences ... an adventure." Soil represents the beginning (and end) of all terrestrial life and is logically the topic of the first chapter where it is treated more fully than most books of this nature. Ecosystems, population cycles, social behavior of wildlife, movement of species into new habitats, and man (as a part of all ecosystems) form the subjects of the remaining chapters. The numerous color photographs give the book its particular appeal.

# Evolution and Adaptation

Aruego, Jose. Symbiosis: A Book of Unusual Friendships. Illus. Scribner, 1970. $3.95. Gr. 1 - 3.

A cheerful book, comically illustrated, about a very real and marvelous phenomenon, symbiosis, or the interdependent relationship between two living forms. If children take this presentation seriously at the same time they enjoy it, they are not likely to forget just how nine pairs of animals help each other out.

Atwood, Anne. The Wild Young Desert. Illus. Scribner, 1970. $4.95. Gr. 6 - Adult.

A photographic essay portraying stunningly the evolution of land surfaces by wind and water. Such phrases as "savage wind softens" and "warped with wildness" typify the poetic text, which conveys the power of natural forces in shaping the face of the earth. The sharp, colored photographs capture the patterns of changing land features at moments when the contrast between sunlit and shadowed surfaces are strongest. Another magnificent book by Ann Atwood is New Moon Cove.

Burton, Virginia Lee. Life Story: a Play in Five Acts. Illus. Houghton, 1962. $5.50. Gr. 3 - 6.

Dramatic devices such as illustrations framed by proscenium arches and placards announcing act and scene numbers are used to portray the evolution of the earth. Particularly commendable is the final synthesis, which shows the relationships of various types of living creatures to the endless chain of time.

Hotton, Nicholas III. The Evidence of Evolution. Published by American Heritage in association with the Smithsonian Institution; book trade and institutional distribution by Van Nostrand, 1968. $4.95. Gr. 7 - Adult.

A magnificent, highly authoritative reference book, presenting the origin and evolution of life and the evidence for organic evolution. Not only fossil records provide evidence but also the "interaction of living individuals with each other and their environment." This comprehensive work closes with a discussion of man, whose questing mind permitted him to exploit his environment. Hotton reminds us that most of the problems we face today, such as overcrowding, are evolutionary in origin and that we have not learned to cope with our own cleverness. Illustrating the text are 135 paintings, photographs, diagrams, drawings, and charts, 40 of them in color.

Ravielli, Anthony. From Fins to Hands: An Adventure in Evolution. Illus. Viking, 1968. $3.00. Gr. 5 - 7.

While focusing on the modification of the forelimb from the lobe-finned fish (the first vertebrate to venture onto dry land) to the human primate, the author integrates the most salient aspects of vertebrate evolution. Among intriguing aspects is that the human hand, with its retention of the five-fingered primitive condition, is unspecialized and yet advanced --its increasing manipulatability throughout primate evolution permitting the development of the brain and human culture. The pen drawings are extremely graphic and include reconstructions of amphibians, reptiles, and mammals known only from fossils. Despite the picture book format, the complexity of the evolutionary principles involved suggest that this book would best be used with older readers.

Shuttlesworth, Dorothy. Animal Camouflage. Illus. by Matthe Kamenoff. Natural History, 1966. $3.95. Gr. 6 - 9.

A very informative book which describes the various kinds of camouflage animals have inherited to further increase the chance of their species' survival. A diagram shows how skin color changes, and many other beautiful and accurate illustrations, some in color, amplify the text.

Silverstein, Alvin and Virginia. A Star in the Sea. Illus. by Symeon Shimin. Warne, 1969. $3.95. Gr. 1 - 5.

The story of a starfish named Stella: her birth, development (fertilization and cell division are included), eating habits, peculiar adaptations, enemies, and reproduction. A point is made of the fact that starfish may produce millions of eggs and sperm since this ensures that at least some will be fertilized and escape the jaws of a fish. The illustrations are in vivid colors and are very attractive.

Simon, Hilda. Partners, Guests, and Parasites: Coexistence in Nature. Illus. Viking, 1970. $4.95. Gr. 6 - Adult.

Hilda Simon begins her book by pointing out that the "struggle for survival" according to the Darwinian theory, does not always involve violence and aggression among organisms, but that natural selection also favors cooperation between different species. Her book is about symbiosis. Its examples represent most of the classes of animals and describe the many different types of symbiotic relationships. The author's four-color drawings are equisite and exact in detail.

# Man and His Environment

Belting, Natalia. The Earth is on a Fish's Back: Tales of Beginnings. Illus. by Esta Nesbitt. Holt, 1965. $3.50. Gr. 4 - 6.

One of the author's many books of legends, this one contains tales from all over the world which attempt to explain the origin of such things as the sun, the salty ocean, weaving, and fire. The characters in many of the tales are animals. For example, in "Why there is Both Day and Night," men did not yet exist. This collection should suggest to children what elements in the world peoples have considered puzzling and most vital to their existence.

Jablow, Alta and Carl Withers. The Man in the Moon: Sky Tales from Many Lands. Illus. by Peggy Wilson. Holt, 1969. $4.50. Gr. 4 - 6.

This folklore collection represents cosmographic tales told by men everywhere who have wondered as they gazed up at the heavens. In the afterword, the authors draw a contrast between the way in which the moon, sun, stars, and thunder are depicted in the oral literature as "very lively actors" or as "objects interestingly or amusingly conceived" and the description of the moon's surface during the Apollo 11 flight ("stark and desolate"). Because of the development of Western science, we are not likely to have the same animated perceptions of celestial beings, but through these tales we can come to appreciate how imaginatively different peoples have described, and accounted for, sky phenomena.

Mendoza, George. The Hunter I Might Have Been. Photographs by DeWayne Dalrymple. Grosset, 1968. $3.59. Gr. 3- Adult.

A photographic essay of less than seventy-five words, simple but poignant, and conveying the sorrow, fear, conviction, wistfulness, and self-recognition of a young hunter who shot a sparrow. The full-page black-and-white photographs depict the mood stunningly.

Nyblom, Helena. The Witch in the Woods: Fairy Tales from Sweden. Trans. by Holger Lundbergh. Illus. by Nils Christian Hald. Knopf, 1968. $4.50. Gr. 3-6.

As in most fairy tales, the princes, princesses, kings, trolls, and witches playing roles in these stories are very human. Particularly noteworthy of Helena Nyblom's tales are that they take place in the countryside, and woven into them are such natural elements as spruce, elm, birch, linden, and lingonberries.

Reed, Gwendolyn ed. The Talkative Beasts: Myths, Fables, and Poems of India. Photographs by Stella Snead. Lothrop, 1969. $4.95. Gr. 3 - 7.

A very appealing book, containing a selection of Indian folk and fairy tales, poems, jatakas, proverbs, and myths about animals, which demonstrate the Hindu reverence for all life. Black and white photographs of sculptured beasts of India illuminate the large pages.

## Picture Books

Beskow, Elsa. Children of the Forest. Illus. Adapted from the Swedish by William Jay Smith. Seymour Lawrence: Delacorte, 1965. $4.50. Gr. K - 3.

The squirrel-sized forest children and their parents are dependent on the mushroom for their existence: they wear red caps with white dots as protective coloration against enemies who mistake them for poisonous mushrooms; they find shelter under mushrooms during rainstorms; and they learn to recognize edible mushrooms which they eat year-round. The children frolic with frogs and squirrels and like other forest creatures, they gather berries and nuts for food and cotton grass for warmth. The lyrical verses tell of their days in the wild woods, but the exquisite illustrations tell more: in each the little people are integrated into the environment, as much a part of nature as the rabbits and owls.

Burton, Virginia Lee. The Little House. Illus. Houghton, 1942. $3.75. Gr. K - 3.

A picture book about a little house in the country which is encroached upon by all the elements of urbanization. One wonders at the end, when the little old house is moved out to the country again, whether this is a real solution. How long will it be before she is surrounded by buildings and busy streets again? The popular Mike Mulligan and His Steamshovel by the same author, represents the antithesis of The Little House for, as Margaret Heylman points out in "The Little House Syndrome vs. Mike Mulligan and Mary Ann" (see "additional bibliographies"), the problem of what to do with Mary Ann is solved resourcefully by incorporating her into the new town hall.

Carrick, Carol. Swamp Spring. Illus. by David Carrick. Macmillan, 1969. $4.50. K - 2.

From the time when "spring is frozen in the swamp," until the day "new life begins among the tangled roots," the reader follows the gradual transformation of the swamp as it is depicted in poetic prose and striking watercolor illustrations. As the snow and ice thaw, the ducks, beaver, snakes, frogs, rabbits, and owls stir from their nests and search for food. The skunk cabbage, marsh marigolds, reeds, plant scum, and trees all provide warmth, food, and cover for these creatures.

Caudill, Rebecca. A Pocketful of Crickets. Illus. by Evaline Ness. Holt, 1964. $3.50. Gr. K - 3.

It takes six-year-old Jay a long time to return home with the cows. His eyes scan the countryside --hills covered with woods and pasture; he walks forward in the soft, warm dust and then backward to look at his footprints in the dust; he watches a half-dozen small creatures and knocks a frost-smelling nut from a hickory tree; he finds a goose feather, an Indianhead, and wonderful white beans striped with red speckles; then he catches a cricket who becomes his friend and whom he learns to share with his classmates on his first day of school. This is a pastoral picture-book with a text emphasizing the senses. The illustrations are vigorous in red and gold, colors appropriate for the late summer setting.

Clymer, Eleanor. A Big Pile of Dirt. Illus. by Robert Shore. Holt, 1968. $3.95. Gr. 1 - 6.

The children could not have received a nicer "present" than the big pile of dirt dumped by mistake in the middle of an empty lot. Shooed from the stoops, furnace room, hallways, and roof tops of the broken-down tenements by adults, they find their "mountain" of "clean dirt" a sanctuary, offering a wealth of things to do. The children, and their parents, defend their need for the lot when the mayor and some ladies plan to clean it up, and even when the mayor has it converted into a fine park for them, the reader tends to share the nostalgia of Mike, the narrator, for the days when the lot was "the way it used to be," when everything about it was a result of their own activities and creativity. The illustrations, in brownstones, are very effective in transmitting the environment of a slum.

Fisher, Aileen. We Went Looking. Illus. by Marie Angel. Crowell, 1968. $3.95. Gr. K - 3.

Even if we did not find the badger we went looking for, we did see creatures no less significant. We almost passed by the caterpillar "looking just exactly like a twig," but did spot two dozen other small woodland creatures. The simple text is in pleasing rhyme and the softly-colored illustrations are effective.

Freschet, Bernice. The Old Bullfrog. Illus. by Roger Duvoisin. Scribner, 1968. $3.50. Gr. K - 3.

A smug-looking bullfrog, a hungry heron, and a host of other pond critters carry off the suspense of this simple survival story. The frog has lived many years because he is wise, the young reader learns. A teacher might use this picture book to point out that it was not just the bullfrog's concealed alertness that saved him from the heron's strike, but also his ability to spring instantly, his strong hind legs representing a special adaptation permitting the species' survival. The collage illustrations are very distinctive, having vibrant colors and texture.

Keith, Eros. A Small Lot. Illus. by the author. Bradbury, 1968. $4.25. PreS - 2.

Although the surface message of this picture book is not very original, the whimsical illustrations more than compensate for it. The wash drawings in bright pastels tell the story of two small boys who save a vacant lot for their own play by preventing the construction of a pet shop. An older reader might recognize the underlying message that children can be more content playing in the worlds of their imaginations (castles, jungles) than viewing pets, flowers, or toys in shops.

Lionni, Leo. Inch by Inch. Illus. by the author. Obolensky, 1960. $3.95. Gr. K - 3.

The prey outwits the predator in this graphical episode of an inchworm. The twigs, leaves, and flowers of plants and the feathers and beaks of birds are drawn in realistic colors and have a textured pattern reminiscent of silk-screening.

Miles, Miska. Nobody's Cat. Illus. by John Schoenherr. Atlantic-Little, 1969. $3.75. Gr. K - 3.

An animal in the city, belonging to no one in particular, faces dangers as great as those of an animal in the wilderness. This cat survives because he has adapted with prowess to the ways of man (knowing, for example, where and how to obtain food from humans) and to man's dogs and autos. The illustrations and descriptions of the cat, so tense and alert, are very realistic.

Piatti, Celestino. The Happy Owls. Atheneum, 1964. $4.95. Gr. K - 3.

A legend having overtones of ecology. It is the wise owls who appreciate and live in harmony with nature, who also live in harmony with each other --in contrast to the domestic barnyard fowl who are not aware of the different seasons' beauties and squabble when they are not sleeping, eating, or drinking. The pictures are magnificent, in bold, bright colors outlined with black.

Schoenherr, John. The Barn. Illus. Atlantic-Little, 1968. $3.50. Gr. PreS - 3.

A picture book with double-page black-and-white drawings and simple but intense text portraying the struggle for existence of an owl and a skunk. It is a time of drought and frogs, mice, eggs, and beetles are few. Although the hungry skunk is a predator himself, he becomes prey as the owl attempts to satisfy the hunger of her young ones.

Tresselt, Alvin. Rain Drop Splash. Illus. by Leonard Weisgard. Lothrop, 1946. $3.50. PreS - 3.

A delightful book, its simple text beginning in the rhythm of the plunking rain drops and then flowing with the river to the sea when the rain stops. The attractive, unsophisticated pictures depict not only the wild creatures of the woods and streams, but also the farms, domestic animals, cities, factories, bridges, boats, and ships of man. The falling rain makes no distinction between the wild and tame and mingles freely everywhere.

Valens, Evans G. and Clement Hurd. Wildfire. Illus. by Clement Hurd. World, 1963. $3.95. K - 4.

A stunning story of an autumn forest fire told in strong, poetic images. The block-print illustrations are superb, depicting the multitudinous forest creatures fleeing in confusion from their homes, against a background of pulsing vegetation --the impressions of genuine ferns and leaves. The roaring flames destroy but do not quench all life, and the following spring, seeds sprout from the enriched forest floor. With the appearance of new green life, birds and animals return to the burn to feed.

## Various Fictional Books

Ellis, Mel. Ironhead. Holt, 1968. $3.95. Gr. 5-9.

Set in the Florida Everglades, this is a story full of adventure and appeal for young outdoorsmen. The main character is Doug Doucette, a teenager who sets out to capture a huge rattlesnake. If sold, this enormous reptile would provide enough money to secure care for the boy's ailing father. The exciting descriptions of Doug's encounters with the wildlife and capricious elements in the swamp are the most distinguished qualities of the book by the 1961 Wisconsin Conservation Writer of the year.

Ellis, Mel. Sad Song of the Coyote. Holt, 1967. $2.95. Gr. 7 - 10.

The story of a boy's conflict --"the old ways against the new ways." Mark Trent, the son of a gamekeeper, understands why his father and farmers value only the dead coyote for its pelt and bounty, but he is drawn to the view of biologists and conservationists who believe that coyotes and other predators do more good than harm. He wrestles between his need to hunt coyotes for the money they bring for his education, and his growing sympathy with these rare animals with the mournful howl. The conflict is resolved gradually and realistically with retention of the well-developed characterizations.

Guillot, Rene. Grishka and the Bear. Trans. by Swen Marsh. Illus. by Joan Kiddell-Monroe. Criterion, 1960. $3.50. Gr. 3 - 7.

The story of a Siberian tribe who has an agreement with the black bears of the mountains to hunt them only during a certain season and only after a messenger has been sent to them reporting the date. Grishka, a courageous young boy, rescues, rears, and becomes a loyal friend of Djidi, a bear cub. When full-grown, Djidi does not understand why the men want to hurt him.

Holling, Holling Clancy. Tree in the Trail. Illus. Houghton, 1942. $4.95. Gr. 4 - 6.

A lone cottonwood grew near the watering place of buffalo on a low hill in the midst of the Kansas plains. Its twisted shape, ornaments, and imbedded arrowheads and silver slivers, told its story as a "companion to bird, beast, and man." During its lifetime it offered shelter and protection to Indians, Spanish warriors, and American traders, and witnessed the changing scene of the plains. The cottonwood's limbs seemed always to be beckoning towards the West and finally, before the plains were criss-crossed with fences and dotted with farms, it did travel beyond the hill, carrying with it, peace. Other beautiful books by this author having ecological overtones are Paddle-to-the-Sea, Minn of the Mississippi, and Seabird.

Holman, Felice. The Blackmail Machine. Illus. by Victoria de Larrea. Macmillan, 1968. $4.50. Gr. 3 - 7.

A clever, bubbly, but pointed story about five children and a Miss Shrubb who take advantage of their air-borne situation (in a propellor-driven treehouse) to force the unsensible and trifling grownups to change their ways. Their first demand is to save the tidal marsh (where Miss Shrubb dwells among its wild inhabitants) from the mayor who has schemed to drain and junk-fill it for a race track; it is met only when the townspeople realize that, among other equally selfish reasons, the birds which depend on the marsh for shelter and food, eat the insects which would otherwise destroy their crops. The other demands, for world peace and less apathy, are curiously similar to those of older students who in real life are trying to gain some influence in governmental policies.

Hunt, Irene. Trail of Apple Blossoms. Illus. by Don Bolognese. Follett, 1968. $3.95. Gr. 4 - 8.

A beautifully-written story using the American folk hero Johnny Appleseed to convey the philosophies of working with nature and reverence for life. Besides caring for apple trees and distributing seeds, Johnny Chapman cured sickness with wholesome food, healed wounds with herbs, and by walking fearlessly and unarmed, befriended Indians and wild animals.

Lawson, Robert. Rabbit Hill. Illus. Viking, 1944. $3.50. Gr. 4 - 6.

The "New Folks" finally arrive at the long-empty house and ultimately dispell the fears of the animals dependent on the vegetation surrounding it, that the people will be unsympathetic with the needs of wild creatures. Indeed, the animals learn that the man and the lady are perfect co-inhabitants --"real sensible, knowledgeable Folks ... quiet-like and friendly," and providers of "enough (food) for all." The scene inside the front and back covers is a perfect example of good land management --the hedgerows, shrubs, and trees attracting a diversity of wildlife. The other drawings are incredibly realistic and striking in detail, and as for the text, it's all charm and warm humor.

Montgomery, Rutherford. Kildee House. Illus. by Barbara Cooney. Doubleday, 1949. $3.50. Gr. 4 - 6. (Paperback: Archway, 1968. $.50).

Jerome Kildee learns how to talk to and care for other people after he has retired into a redwood forest and been accepted by the skunks and raccoons sharing his home at the foot of a massive tree. Jerome adapts himself and his house to the animals (numbering 52 by the time a solution is found) and although they take advantage of him, he neither withholds his services from them nor claims ownership of them. The animals also provide the core around which friendships grow between Jerome and Emmy Lou and eventually between Emmy Lou and Donald. These three plus Ben Eppy and the game warden have individual wildlife ethics for the reader to identify.

Rawlings, Marjorie Kinnen. The Secret River. Illus. by Leonard Weisgard. Scribner, 1955. $2.97. Gr. 1 - 4.

Hard times have come to the forest in which Calpurnia lives. The little poetess is concerned, and she finds her way to the secret river with her dog where she catches enough catfish to bring soft times to the forest people. Never again does she find the river. Is it real? We may believe whatever we like. Almost all of us have come upon some magical place so beautiful and perfect it seems unreal. This book suggests that it's not easy to separate reality from imagination.

Smith, Agnes. An Edge of the Forest. Illus. by Roberta Moynihan. Viking, 1959. $3.37. Gr. 7 - Adult.

An unusual and hauntingly beautiful story of a small black lamb who brings new things to "The Young Woods." Predator ceases to harm prey for the sake of the lamb. Love and security is only briefly interrupted by fear and death. The realm of the leopards, owls, deer, and mice includes grasslands, swamps, and both young and old forests. The plant communities of each are described graphically so that the reader gains a sense of the importance of green plants for food and cover. A shepherd and his family live near the edge of the forest and although they are tied to the woods psychologically through their love of the black lamb, there is little understanding between the humans and the forest animals.

Thompson, George Selden. Tucker's Countryside. By George Selden, pseud. Illus. by Garth Williams. Farrar, Straus, 1969. $3.95. Gr. 7 - 9.

A winsome book about Tucker Mouse, Henry Cat, Chester Cricket, Henry and Emily Chipmunk, Simon Turtle, and "various rabbits and sundry fieldmice" who prevent their Old Meadow from being drained and their homes replaced by a tall, brick and concrete apartment building. It is Tucker who finally hits on the plan ("I got it!" he cried as he jumped three feet straight up), a plan which involves lying, burglary and forgery (to Chester's dismay) but which they prefer to call "benign deception" since it is "for everybody's good, including the good of human beings who don't have brains enough to leave nice meadows alone." A good book to read aloud to primary age children (unless one does not believe the end justifies the means).

Turkle, Brinton. Fiddler on High Lonesome. Illus. Viking, 1968. $3.50. Gr. 2 - 4.

In contrast to the sour Fogel brothers, scoundrels who carry guns and kill "varmits" for the fun of it, their small orphaned cousin, Bochamp, plays his fiddle for the forest critters; bears, skunks, and even a panther dance in the moonlight to his tune. But the response of Hunk, Deet, and Sud to this sight tells Bochamp that he "ain't no kin of yourn."

White, E.B. Stuart Little. Illus. by Garth Williams. Harper, 1945. $3.95. Gr. K - Adult. (Paperback: Dell, 1967. $.75).

The charming story of a gentleman-mouse who leaves his parents, the Littles, to head north in search of a bird named Margalo. In contrast to the city he left (New York), he comes upon a town "where the houses were white and high and the elm trees were green and higher than the houses, where the front yards were wide and pleasant and the back yards were bushy and worth finding out about, where the streets sloped down to the stream and the stream flowed quietly under the bridge, where the lawns ended in orchards and the fields ended in pastures, and the pastures climbed the hill ..." A telephone man directs Stuart north into an area of "swamps where cedars grow and turtles wait on logs but not for anything in particular ... pastures rank with ferns and junipers ... spruce woods ... fresh lakes undisturbed except by fish and hawks and of course, by the Telephone Company." Stuart feels it's the right direction for him and maybe it is for all of us --if such lands still exist.

White, E.B. The Trumpet of the Swan. Pictures by Edward Frascino. Harper, 1970. $4.11. Gr. 4 - 6.

Louis, a trumpeter swan, is born mute. Unable to court a lovely swan, Serena, he solves his problems by learning to play a trumpet. This is a memorable book, full of humor and truth; and because of its focus, there is much to intrigue anyone with an interest in nature or conservation.

## Survival Books

Carpenter, Edmund, ed. The Story of Comock the Eskimo. As told to Robert Flaherty. Illus. Simon & Schuster, 1968. $4.50. Gr. 5 - Adult.

A true story told to Robert Flaherty in north-eastern Quebec in 1912 when Comock and his family arrive from an island where they had been living for ten years. Forced by starvation to move to better hunting grounds, a break in the ice had separated Comock from part of his family and most of his supplies. From the terse, lucid text and stark sketches, portraying tiny Eskimo figures in vast fields of white, the reader gains a strong impression of the Eskimo's world view, dependence on wildlife, and resourcefulness.

Cleaver, Vera and Bill. Where the Lilies Bloom. Illus. by Jim Spanfeller. Lippincott, 1969. $3.50. Gr. 6 - 9.

The local color of Appalachia brings sparkle to this warm, touching story. The main character is Mary Call, a resourceful and intelligent young lady who keeps her orphaned family together. One particularly fascinating device for their survival is the practice of wildcrafting, the harvesting of wild buds, leaves, and bark for medicinal use.

Defoe, Daniel. Robinson Crusoe. Illus. by N.C. Wyeth. Scribner, 1957. $6.00. Gr. 6 - Adult.

A classical story of survival.

Ellis, Mel. Flight of the White Wolf. Holt, 1970. $3.97. Gr. 6 - 8.

Branded as a dangerous killer after slaying a valuable boxer that had taunted him, Gray, a white wolf, is led to safety by a boy that had raised him from the time that he was a pup. Set in Wisconsin and filled with details on the wildlife of the state, this is an enthralling tale of the duo's survival as they strive to reach a Wildlife Reserve upstate.

George, Jean Craighead. My Side of the Mountain. Dutton, 1959. $3.95. Gr. 4 - 6.

What boy, or girl, has not dreamed of living inside of a tree? This first person account relates the year-long adventures of a boy from New York City who leaves his family and his dependency on electricity and machines to live off the land in a Hemlock forest of the Catskill Mountains. At first he wonders how primitive man ever had enough time and energy for more than hunting food; later he becomes exhilarated over his self-sufficiency, but his longings to exchange words with humans become more frequent.

Miles, Miska. Hoagie's Rifle Gun. Illus. by John Schoenherr. Atlantic: Little, 1970. $3.50. Gr. 1 - 3.

When eleven year old Hoagie stalks a rabbit to help to feed his family, his prey is taken from him by a bobcat, who is also hungry. Parallels in the struggle for survival between the poor Appalachian family and the wily animal are sharply delineated in the black and white illustrations.

O'Dell, Scott. Island of the Blue Dolphins. Houghton, 1960. $3.50. Gr. 7 - up.

A fictionalized story of an Indian girl who actually lived eighteen years alone on a Pacific Island. She not only learned to use all the parts of animals and plants for food, shelter, tools, clothing, baskets and canoes, but in making friends with animals she once killed, she also learned that "animals and birds are like people, too."

Sperry, Armstrong. Call It Courage. Macmillan, 1940. $3.50. Gr. 4 - 6.

A 1941 Newbery Medal winner, this Polynesian legend forcefully relates the struggles of a boy who conquers his fear of the sea.

Taylor, Theodore. The Cay. Doubleday, 1969. $3.50. Gr. 6 - 9.

A first-person narrative, very convincing in its characterization of an American boy who overcomes his social prejudices, self-centeredness, and dependency when he is forced to share a tiny Caribbean island with a wise, black seaman. Blinded from a blow on his head when their ship was torpedoed and sunk, the boy becomes resentful and hostile. Midway through the book, the boy speaks his mind, and this becomes the turning point in his attitude toward the old man.

## Biography

Douglas, William O. Muir of the Mountains. Illus. by Harve Stein. Houghton, 1961. $2.95. Gr. 7 - 11.

A sympathetic biography of the 19th century conservationist John Muir, who stopped farming (a lucrative but monotonous occupation to him) so that he could wander in his beloved mountains, woods, and meadows, and then write books relating what the wilderness means to man. The preservation of many giant sequoias in California is among results of his eloquent pleas. Douglas includes many quotations from Muir's writings which convey his reverence for every flower, tree, and bird, and his conviction that man's job is to protect, not destroy, all other living things.

North, Sterling. Rascal: A Memoir of a Better Era. Illus. by John Schoenherr. Dutton, 1963. Gr. 5 - Adult. (Paperback: Camelot-Avon, 1969. $.75.).

The author recalls his year-long companionship with a wonderfully affectionate raccoon. As a twelve-year-old boy at the end of the first world war, Sterling makes a "peace treaty" with all wild animals which he had previously trapped for their furs. Children and adults from Wisconsin will especially appreciate his reflective descriptions of the hills and woods he explored near Lake Koshkonong in southern Wisconsin and also the Brule River in the northwest part of the state. North has written a shortened and simplified version of this book called Little Rascal, with numerous, fine drawings by Carl Burger.

North, Sterling. The Wolfling: A Documentary Novel of the Eighteen-Seventies. Illus. by John Schoenherr. Dutton, 1969. $5.95. Gr. 7 - Adult.

A stirring, documentary novel depicting life in southern Wisconsin one hundred years ago when house-raisings and wolf hunts were welcome diversions, and a boy had to "buy time" from his father to go fishing. The book's authenticity is manifest in the documentary notes. The author's father, David Willard North (1862-1962), is a prototype of Robbie Trent, the boy in the story who takes the wolfling from a den and raises it. Without this book Robbie's intriguing neighbor, Thure Kumlien, might only be known to those whose ancestors lived near Lake Koshkonong and told of the Swedish naturalist's profound knowledge of wildlife and retiring life style. Sterling North brings him alive as he does the other Wisconsin pioneers who experienced the Civil War, Chicago Fire, and Panic of 1873.

Sterling, Phillip. Sea and Earth: The Life of Rachel Carson. Crowell, 1970. $4.50. Gr. 7 - up.

A well-written account of the life of the woman who wrote the controversial Silent Spring and widely-read books about the sea. The author stresses her literary as well as scientific interests. In tracing the source and background of her environmental concern, he describes the social, economic, political, and ecological climate in which she lived.

## Appreciation

Clark, Ann Nolan. Along Sandy Trails. Photographs by Alfred A. Cohn. Viking, 1969. $4.95. Gr. 3 - 6.

An unusual presentation told in the poetic diction of the Papago Indian and illustrated by superb color photographs. A Papago grandmother and her granddaughter walk along a path in a southwestern desert and talk about the wildlife they see. The little girl learns that the giant cactus not only supplies them with luscious fruit and rain water (stored in its trunk), but when dead can be used to make house walls and fences. To one of her granddaughter's questions the old woman replies, "There are some things no one knows."

Lewis, Richard, ed. In a Spring Garden. Illus. by Ezra Jack Keats. Dial, 1965. $4.50. Gr. 4 - up.

Haiku poems characterized by simplicity, intensity, and fresh beauty accompanied by striking illustrations in color and collage. Small, lake-side critters are the subjects of most of the poems and are pictured in their natural habitats against a sky of varying moods. As a whole, the poems and illustrations depict the course of a summer day, climaxed by a thunderstorm.

Lewis, Richard, ed. Out of the Earth I Sing: Poetry and Songs of Primitive Peoples of the World. Norton, 1968. $4.95. Gr. 4 - Adult.

The poems, chants, and prayers collected into this anthology sing of nature, birth, death, and love. They are derived from primitive peoples in all parts of the world and reflect the continuity in time and space of certain human themes. The strength of the songs and poems is in their simplicity and directness. These are strikingly complemented by black and white reproductions of primitive art.

North, Sterling. Hurry Spring! Illus. by Carl Burger. Dutton, 1966. $3.95. Gr. 4 - 6.

A beautifully-written book in which the author's deep appreciation for the natural world penetrates quietly. His anecdotes, though lyrical in style, present intriguing information about animals awakening from hibernation, and about other spring happenings.

Reed, Gwendolyn, ed. Bird Songs. Illus. by Gabriele Margules. Atheneum, 1969. $4.25. Gr. 2 - 7.

Poems-to-delight, about very familiar birds. The eighty-one pieces, by such masters as Longfellow, Keats, Frost, Sandburg, Dickinson, and less well-known poets, are accompanied by cheerful drawings and are arranged in such a way as to let the pages "breathe."

Rounds, Glen. Rain in the Woods and Other Small Matters. World, 1964. $3.00. Gr. 4 - 6.

A fine book to read aloud to children before setting out on a field trip to a woods or pond. From it we may learn to consider very small creatures from a different point of view. They abound in our surroundings (under our feet!), usually unnoticed by those of us who expect to see and hear only big animals when we are out walking. Large, fierce predators which we read about, fascinate us, but a myriad of creatures, tiny but no less wild or ferocious, exist right in our neighborhood's vacant lot or in any stagnant water. To see them we must squat low on the ground and, like the author, wait patiently. Rounds' graphic descriptions convey his ability to not only observe details but also to see the humorous and human aspects of animal behavior. His marginal pen-and-ink drawings have a touch of the pixie in them

Skrebitski, G.A. In the Forest and On the Marsh. Trans. by Anne Terry White. Illus. Braziller. $3.95. Gr. 6-9.

The writer of this collection of anecdotes is a hunter who conveys not only his joy in stalking prey but also his sensitivity to the beauty and spirit of the animals he kills. He hunts rabbits, bear, blackcocks, and ducks in the Russian forests and marshes, but always with discretion, often bringing home and caring for as many animals as he shoots. His accounts are colorful and reflect the character of the Russian people with whom he shared many of his experiences. A good book to read aloud and to stimulate a discussion of why restricted hunting is sometimes beneficial to wildlife populations.

## Natural Resources

Baker, Laura Nelson. A Tree Called Moses. Illus. by Penelope Naylor. Atheneum, 1966. $3.50. Gr. 2-4.

The story of a giant sequoia which began its life one spring 2500 years ago from a seed, cached and forgotten over the winter by a squirrel. Surviving one threat to its life after another and winning competition with other plants for nutrients, sunlight, and space, the Moses tree continues to grow. It witnesses predatory activities of grey wolves and mountain lion as a young tree, and 2000 years later the destructive activities of lumber-hungry white men. Fire, forcefully depicted as a starving licking beast, is the tree's greatest enemy and also man's, since he is dependent on the forest as a watershed. Children could represent the life of Moses on a mural-size graph, the axes showing time and tree height.

Ellis, Mel. Wild Goose, Brother Goose. Holt, 1969. $4.95. Gr. 7 - Adult.

A reader of this book will never watch a flock of geese flying in V-formation, or listen to that "clear fluting from the sky," without thinking of Duke, the undaunted Canada gander who weathered every conceivable storm and remained a determined widower after his pinioned mate was struck dead by a dog. Hunters, traps, tornadoes, starvation all leave their marks on Duke's body and toughen his spirit. Much can be learned of geese behavior but enough questions remain to leave the reader marveling: Why didn't Duke later mate with the wounded goose he escorted over ice and snow to the farm where his first mate died? The author writes as if he were actually observing Duke over the two year period, without being anthropomorphic. Wisconsinites will especially appreciate this book since it describes the towns, cities, marshes, lakes, and rivers of this state from bird's eye view. But it also depicts the change man has wrought on the land. Duke looks down on "poison clouds marking cities ... a clutter. No plan, nor any pattern. Houses strewn like hail stones. Roads wrapping around onto themselves. No world of his, nor of any wild thing."

Graham, Ada and Frank. Wildlife Rescue: Alternative to Extinction. Illus. with photographs. $4.95. Gr. 7 - Adult.

A very welcome book for its focus on some happy outcomes of conservation efforts, complementing those books portraying man as the villain of wildlife extinction. The authors describe the authentic experiences of four individuals who were independently responsible for the rescue of wild creatures in the United States and the rest of the world. Many direct quotations of these persons bring an immediacy to their accomplishments.

Gray, Robert. Children of the Ark: The Rescue of the World's Vanishing Wildlife. Norton, 1968. $3.95. Gr. 4 - 7.

Many conservation books focus on the extinction of wildlife species in America, beginning when European settlers cleared forests, plowed prairies, drained and filled swamps and marshes, and dammed rivers. But this book is about other intriguing creatures from England, South Africa, India, Mongolia, Australia, and the Arctic, as well as creatures native to America. Many became endangered species beginning 8,000 years ago when man first began farming land. As the author states, "The animals have no nationality ... They belong to the entire world." He emphasizes mammals but gives examples of birds and reptiles which were saved and are now being protected in game reserves, national parks, and zoos. In the discussion of each species, Gray isolates one female, gives her a name, and describes the birth and growth of her young, thereby incorporating information about the natural history of the species. The descriptions are clear, simple and graphic, and the photographs accompanying each are superb.

Hallin, Emily W. Moya and the Flamingoes. Illus. by Rus Anderson. McKay, 1969. $3.50. Gr. 4 - 6.

A captivating story with good plot strengthened by a portrayal of an African tribe's culture and of flamingoes nesting on a Rift Valley Lake. The young Kenya boy Moya saves the son of an American ornithologist who collapsed from exposure on the salt crusts bordering the secret lake where he went in search of flamingoes. Although Moya experiences grave fears in tampering with the firebirds, his clan's totem, these are overcome as he cures Peter and makes him a blood brother. The tribe elders announce that his stealing of medicine is justified, and Peter's father and a ranger proclaim the lake a sanctuary.

Hurd, Edith Thacher. The Blue Heron Tree. Illus. by Clement Hurd. Viking, 1968. $3.95. Gr. 2 - 5.

This book is the result of three years of observing water fowl and shorebirds at a lagoon in a redwood canyon north of San Francisco. Replenished by ocean tides full of plankton, the lagoon is one of the few feeding and nesting grounds of herons and egrets. Underlying the beauty of the text and illustrations is a plea for the blue heron's continued survival.

Hutchins, Ross Elliott. The Last Trumpeters. Illus. by Jerome Connolly. Rand McNally. $3.50. Gr. 2 - 5.

A muskrat snaps up one of six "eygnets," the young offspring of a pair of Trumpeter Swans; that is the "way of the wild." But the way of the trappers and hunters who followed Columbus to North America almost brought these snow-white swans to extinction. Before it was too late, man did provide a refuge for them and flocks of the trumpeters have since increased. There have been no "Last Trumpeters" but they no longer migrate along their "flyway" between the Arctic and the Gulf of Mexico. This information is included in the form of a clearly-written story about a family of swans and in a special section at the back. Beautiful bright pastel illustrations fill every page.

Lathrop, Dorothy P. Let Them Live. Macmillan, 1954. $3.95. Gr. 4 - 6.

A book stressing the interdependence between all living things and the contribution each creature makes in the total environment. Often man has overkilled certain animal populations only to create other, unforeseen and usually worse, problems. Although she published the book in 1954, the author brings forth issues of which the public is only now becoming aware.

Laycock, George. America's Endangered Wildlife. Illus. with photographs. Norton, 1968. $4.95. Gr. 5 - 9.

On the first page of this wildlife conservation book, the author tells us the important fact that extinction is not new to the world. "But whereas in the past the number of new species which appeared was the same as the number which disappeared, the rate at which species have become extinct has doubled in the last two hundred years." Before presenting some of the dismal facts about the loss due to man, of various animals and birds, he describes the unique characteristics of individual creatures. In this way the reader comes to appreciate how great a loss their extinction really is. The volume ends with a more optimistic chapter entitled "New Hope for Others," an appendix containing a roster of rare and endangered species, a list of organizations concerned with endangered wildlife, and an index.

McClung, Robert M. Lost Wild America; the Story of Our Extinct and Vanishing Wildlife. Illus. by Bob Hines. Morrow, 1969. $5.95. Gr. 7 - Adult.

With infinite attention to detail, this selection documents man's destruction of the wild animals around him. Initially, the book considers the creatures now virtually extinct. The second half of the text describes possible victims of the future. Through the detailed text, the reader is able to find information on many obscure creatures such as the sea mink or California parakeet. The numerous illustrations, the extensive bibliography, and the lucidity of the writing style add to the reference value of this handsome volume.

McCoy, Joseph. The Hunt for the Whooping Cranes: A Natural History Detective Story. Illus. by Rey Abruzzi. Lothrop, Lee & Shepard. 1966. $4.95. Gr. 6 - 10.

A book which is remarkable as a work of suspenseful, story-like non-fiction incorporating elements of natural history and conservation. It relates the eleven-year search in the Canadian wilderness for the only remaining small band of whooping cranes by a team of American and Canadian conservationists. It also includes an historical view of the great birds and scientific information on its habits. The author closes with questions as to the crane's future. Accompanying the text are decorative pen-and-ink drawings, photographs, maps and a bibliography.

Pringle, Laurence. The Only Earth We Have. Illus. with photographs. Macmillan, 1969. $4.50. Gr. 4 - 8.

A clear, compact book which explains how our air, water, soils, and wildlife have become polluted. Comparing the earth to a spaceship, the author emphasizes the fact that our planet has finite space and natural resources. He also reminds us that conservation is concerned not only with preventing forest fires and soil erosion but with the "quality of life for all people, now and in the future;" and we must "be prepared to pay the cost of conservation." Finally, Pringle offers suggestions as to what we can contribute to the conservation movement, asking that we look at old problems in new ways. Photographs, diagrams, a list of conservation groups, a glossary, and an index accompany the text.

Van Dersal, William R. The Land Renewed: The Story of Soil Conservation. Walck, 1968. $6.00. Gr. 7 - 9.

Every important aspect of soil conservation is treated clearly, concisely, and accurately in this revised and expanded edition. The format is also pleasing, each page-long discussion of a topic accompanied by an appropriate full-page photograph. The author has also updated Wildlife for America: The Story of Wildlife Conservation, an excellent coverage of the subject and essentially identical in text style and format to The Land Renewed.

# Materials for Adults

## A Sampling of Additional Bibliographies

Books about the Environment for Children. Madison Public Library, Madison, Wisconsin, 1970.

Engleson, David C. "The Environment of Earth." Wisconsin Library Bulletin, July-August, 1970, Vol. 66, No. 4, Pp. 245-254.

Heylman, Katherine M. "The Little House Syndrome vs. Mike Mulligan and Mary Anne." School Library Journal, April, 1970, Vol. 16, No. 8, Pp. 44-50.

## Selected Books for Background Reading

There are many current books attempting to explain the ecological dilemma, but the following selections are the standard sources of many of the ideas presented:

Brown, Harrison. The Challenge of Man's Future. Viking, 1954. $5.00. (Paperback: Comp. Viking. $1.65).

Carson, Rachel L. The Sea Around Us. Rev. ed. Oxford, 1961. $6.50.

Odum, E.P. and H.T. Fundamentals of Ecology. 2nd ed. Saunders, 1959. $8.50.

Sand County Almanac and Sketches Here and There. Oxford, 1968. (Paperback $1.75).

Storer, John H. The Web of Life. Devin, 1954. $4.50. (Paperback: Signet, 1966. $.95).

Thoreau, Henry David. Walden. Ed. by Edwin W. Teale. Dodd, 1955. $4.50.

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